

# Aviation Week & Space Technology

75 Cents

A McGraw-Hill Publication

August 5, 1963

SPECIAL REPORT:

**NASA Research  
On Aeronautics**

Dassault Mystere 20 Transport







## ADVANCEMENTS IN LIQUID METAL TECHNOLOGY

**LITHIUM**—Opened a columbium loop with pumped lithium at 1000°F, in a vacuum of 10 torr. Determined corrosion and mass transfer, measured creep in containment alloys, built pump, purified and bled equipment.

**CESIUM AND RUBIDIUM**—Opened a columbium loop with pumped rubidium at 1000°F, determined liquid density to 100°F, vapor pressure to 1800°F, specific heat to 1400°F, and latent heat of vaporization to 1600°F. Operated cesium loop for 5000 hours unattended, determined corrosiveness of cesium and rubidium on a wide range of containment alloys at 2000°F.

**NAK**—Designed the SNAP-6 heat exchanger for operation at 1300°F. Determined corrosiveness of NaK in sodium-cerium alloys at 1000°F, in wettable capsules at 100°F for 1000 hours.

**MERCURY**—Designed zero gravity boiler and radiator for SNAP-6, operated boiling Hg condensing loop to determine flow ability and heat transfer; determined solubility of containment alloys in Hg up to 1100°F, determined compatibility of alloys in Hg at temperatures up to 1200°F over a 10,000 hour period.

■ For further information on AGN's progress in liquid metal technology, write for AGN Active Files (A and B).

**AGN**

AEROJET-GENERAL NUCLEONICS/San Ramon, California



## Blind Bolts become part of simplified wing rework saving \$2.8 million!



Blind Bolts being installed in KF101C lower fuselage skin opening, main longerons after wing removal from wreckage. Hi-Shear Corp. portable power units (30-6000 horsepower operated inside aircraft) provide hydraulic power to the Blind Bolt Gun. An operator inside is on upstair and safe for close, non-fused aircraft in respect ready vehicle.

### INSTALLATION TOOLING



**STANDARD  
BOLTING TOOLS**  
are used in specially  
designed steel. Photo  
shows representative  
material 40-50 lbs.



**EXTENDED  
BOLTING TOOLS**  
which 1/2" Bolter  
from standard to the  
in-line standard  
in standard  
offered at 100 lbs.



**OTHER  
BOLTING TOOLS**  
which are used in up  
to 10" in size for most  
bolt lightly loaded  
area. Use as a first  
work when under  
removal of material and  
compression in the  
area in a light spot.



### WRITE FOR 24 PAGE NEW CATALOG

Describe how factors, factors and  
government facilities have used Blind  
Bolts and Blind Nuts in new work or  
for repair. Also describe advantages,  
applications, strength data,  
installation techniques and tooling.

**hi-shear CORPORATION**  
2000 WEST BAYVIEW STREET • THERMIDORE, CALIFORNIA  
94591

U.S. PATENTS 2,754,404; 2,754,405; 2,754,406; 2,754,407; 2,754,408; 2,754,409; 2,754,410; 2,754,411; 2,754,412; 2,754,413; 2,754,414; 2,754,415; 2,754,416; 2,754,417; 2,754,418; 2,754,419; 2,754,420; 2,754,421; 2,754,422; 2,754,423; 2,754,424; 2,754,425; 2,754,426; 2,754,427; 2,754,428; 2,754,429; 2,754,430; 2,754,431; 2,754,432; 2,754,433; 2,754,434; 2,754,435; 2,754,436; 2,754,437; 2,754,438; 2,754,439; 2,754,440; 2,754,441; 2,754,442; 2,754,443; 2,754,444; 2,754,445; 2,754,446; 2,754,447; 2,754,448; 2,754,449; 2,754,450; 2,754,451; 2,754,452; 2,754,453; 2,754,454; 2,754,455; 2,754,456; 2,754,457; 2,754,458; 2,754,459; 2,754,460; 2,754,461; 2,754,462; 2,754,463; 2,754,464; 2,754,465; 2,754,466; 2,754,467; 2,754,468; 2,754,469; 2,754,470; 2,754,471; 2,754,472; 2,754,473; 2,754,474; 2,754,475; 2,754,476; 2,754,477; 2,754,478; 2,754,479; 2,754,480; 2,754,481; 2,754,482; 2,754,483; 2,754,484; 2,754,485; 2,754,486; 2,754,487; 2,754,488; 2,754,489; 2,754,490; 2,754,491; 2,754,492; 2,754,493; 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#### AEROSPACE CALENDAR

- Aug. 12-14—Guidance and Control Conference, American Institute of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Mass.
- Aug. 12-16—Conference on Artificial Sensing, Virginia Polytechnic Institute, Blacksburg, Va., in cooperation with the National Science Foundation and NASA.
- Aug. 14-26—1973 Biennial Gas Dynamics Symposium, Northwestern University, American Institute of Aeronautics and Astronautics, Evanston, Ill.
- Aug. 15-26—Annual Meeting, Fluid Physics, Ames Area, Ames (Chapen), Ill.
- Aug. 19-21—Advisory Panel Conference, American Institute of Aeronautics and Astronautics, Yale University, New Haven.
- Aug. 19-21—1973 Congress Engineering Conference, Boulder, Colo. Sponsored by University of Colorado, NBS, Oregon Engineering Laboratory.
- Aug. 26-28—1973 Wireless Electronics Show and Conference (WESCON), Cow Palace, San Francisco, Calif.
- Aug. 21-25—National Conference on Microwaves Structures, Theory and Analysis, Research and Development (The Lockheed Martin & Space Co., Palo Alto, Calif.) (Attendance by invitation).
- Aug. 25-28—Simulation for Aerospace Flight Conference, American Institute of Aeronautics and Astronautics, Dresher Hilton Hotel, Columbus, Ohio.
- Aug. 28-30—Conference on Physics of Entry

(Continued on page 7)

#### AVIATION WIRE & Space Technology

August 5, 1973  
Vol. 77, No. 4

...the most complete source of information available on the latest developments in the field of aviation wire and space technology. This includes the latest in wire and cable technology, as well as the latest in space technology. The magazine is published monthly and is a must-read for anyone involved in the design and development of aviation wire and space technology.

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## AEROSPACE CALENDAR

(Continued from page 7)

- Sept. 27-28—Society of Experimental Test Pilots' 30th Annual Report to the Aeronautics Administration and Aeronautics Research Society (Hilton Hotel, New York 10-28)
- Sept. 30-Oct. 4—Aerospace Interplanetary Exposition Meeting, American Institute of Aeronautics and Astronautics, Cabo de San Lucas, Baja California
- Sept. 30-Oct. 3—Canadian Electronic Conference, Institute of Electrical and Electronic Engineers, Exhibition Place, Toronto, Canada
- Oct. 1-3—English National Symposium on Space Electronics, Institute of Electrical and Electronic Engineers, Pineside Hotel, Miami Beach, Fla.
- Oct. 3-5—National Aerospace Nuclear Safety Topical Meeting, American Nuclear Society, Albuquerque, N. M. Convention Las Alamos Scientific Laboratory, AFSC, Albuquerque Operations Office, AF Special Weapons Center, AF Directorate of Nuclear Safety, Santa Fe, University of New Mexico
- Oct. 2-4—National Assn. of Air Traffic Specialists, Sheraton-Hilshire Hotel, Dallas, Texas, Dallas
- Oct. 7-9—North National Communications Symposium, Institute of Electrical and Electronic Engineers, Hotel Lincoln, Chicago
- Oct. 7-11—International Air Transport Assn. 18th Annual General Meeting, Rome, Italy
- Oct. 8-13-16th Annual Air Force Research and Engineering Symposium, Air Force Academy, California, Office of Aerospace Research, AFSC
- Oct. 9-11-21st Annual Aerospace Electronics Conference, Aerospace Electrical Society, San Francisco, California, Los Angeles, Calif.
- Oct. 12-13-1963 General Conference, Field Office Aeronautics, Indianapolis, Indiana, Indianapolis, Ind.
- Oct. 13-17-18th Annual Meeting and Conference, Airport Operations Council, Riverside Hotel, New Orleans, La.
- Oct. 14-16-18th Annual Symposium and Symposium, Air Force Command School, State House Hotel, Dallas, Tex.
- Oct. 19-20-18th Symposium on Ballistic Missile and Space Technology, Naval Training Center, San Diego, Calif.
- Nov. 1-3—AF Space Systems Div., AF Ballistic Systems Div., Aerospace Corp.
- Oct. 16-18—Third National Vacuum Symposium, American Vacuum Society, Sheraton-Hilton Hotel, Boston, Mass.
- Oct. 17-18, Oct. 21-23—North Anglo-American Conference, American Institute of Aeronautics and Astronautics-Canadian Association and Space Institute, Royal Astronomical Society, Massachusetts Institute of Technology, Cambridge, Mass. (Oct. 17-18) Queens Elizabeth Hotel, Montreal, Canada (Oct. 21-23)
- Oct. 21-23—Third Annual East Coast Conference on Aerospace and Navigational Electronics, Institute of Electrical and Electronic Engineers, Emerson Hotel, New York, N.Y.
- Oct. 21-23—Conference on Space Electronics, National Civil Register Co.'s, Regis Camp, Dayton, Ohio. Space Automated Systems Division's Propulsion and Flight Dynamics Laboratories



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## WHAT MAKES AN INSTRUMENTATION CABLE FAIL?

Do you recognize perfectly one whole and the assembly the next. Simply manufacturing it to spec isn't good enough. Because almost failure must be built into the cable at every step from design to installation.

Where can a go wrong? At almost any point not adequately anticipated. Here are four of the most common trouble spots.

- (1) Incompatible Insulations
- (2) Filter Material
- (3) Component by-Products
- (4) Shielding

**INCOMPATIBLE PLASTICISERS** A unique form of chemical warfare within cable materials has forced more than one missile program. Plasticizer materials have to be added to compounds to obtain the required flexibility. These additives are seldom compatible with each other. Incompatible plasticizers tend to separate in contact with each other or with solvent vapors attack each other with disastrous effects. (As a prime example, additins in low temperature are susceptible to attack with each other compatible with the insulating materials.)

Metallic ions can control plasticizer migration problems by adding proper materials and by using suitable barriers between components. Many specifications make the use of barrier material optional and a manufacturer whose only concern is price will leave it out.

Rome-Alcoa, in a result of its wide experience with materials always uses barriers where migration could be a problem.

**FILTRATION** When space launchers arrive at your facility, depending on control panel, the launch could be in the improper position. At filter material of compatibility between insulations and filter materials is of prime importance.

In the case of some plastics of rubber the material "memory" can cause it to shrink disproportionately, creating undue stress internally as the cable. This can cause leaking of the insulation.

Only experience can tell a cable manufacturer how to compensate for "memory" and how to control compatibility in filter materials. Experience is unique such as this has given Rome-Alcoa its remarkable record of instrumentation cable reliability.



**COMPONENT LAY-OUTS** Conductors within a cable are a result of installation in the twisting of component conductors. Incompatible materials and improper sequence of lay up can cause uneven stresses in the insulated conductors.

In such cases, individual conductors may actually push through their insulations, causing electrical failure.

Obviously, these mistakes should be avoided during cabling. At this stage in cable construction careful experienced workmanship can provide safeguards against possible trouble later on. Such careful craftsmanship sometimes costs a little more, but it can make the difference between success and failure.

**SHIELDING** Constructed of many coils of fine strands, shielding braids are prone to having breaks and loose ends. These can break through insulations and short out component conductors. Improperly installed, they are the most common cause of shielding failure.

It is cheaper to do it once than to redo it in the field. But it can also be disastrous. Experience on thousands of such shieldings has taught Rome-Alcoa the exact methods which must be maintained, as well as the kinds of problems and training issues.

**HOW TO AVOID TROUBLE** No manufacturer can promise you 100% reliability at every development stage. But it's well beyond that the one way to assure maximum reliability is to have your cable planned and manufactured by a company with depth of experience and a record of reliability in the field.

Rome-Alcoa is frankly one of the few companies that quality. We've been designing and constructing these cables since their first conception—long enough to know what can cause a cable failure, and how to avoid it. If you're planning to design or install instrumentation cable soon, call us.

At a given time for our 14-year history, Rome-Alcoa has been Cable, Cable, Alcoa, and Alcoa. It's not just a name. It's a reputation for excellence in the construction, production, military specifications and our qualifications. For more copy, write Rome-Alcoa Division of Alcoa, Dept. 26-41, Rome, N.Y.

**ALCOA**  
**ROME CABLE**  
S I N C E 1 9 4 2





The versatile J79 turbojet—General Electric's Mach 2, 17,600-pound-thrust powerplant—provides a wide variety of aircraft with a remarkable capability for speed, efficiency, and reliability. Developed to meet the Air Force's rigid requirements for a Mach 2 aircraft, the J79 now powers the USAF's General Dynamics F-16 Hustler and Lockheed F-14 Starfighter, the Navy's North American A-6 Intruder and McDonnell F-4H Phantom II, and the Air Force's new McDonnell F-15. Civilian derivatives of this high-performance engine are found in both the Cessna 440 and 441 commercial jet airplanes, as well as in marine and industrial applications.

Military and commercial versions of the J79 have logged more than two million flight hours—in the course of which J79-powered military aircraft established 37 world class records for speed, altitude, and time-to-climb. Already the owner of more than half the Free World's Mach 2 flight time, this General Electric turbojet is daily accumulating superpower flight hours at an ever-increasing rate.

With continuing advances in reliability and rigorous anti-reflection programs, the J79 is meeting customer demands for maximum performance at reasonable cost—another example of the *Arrest on Valor* from General Electric's Flight Propulsion Division, Evendale, Ohio.

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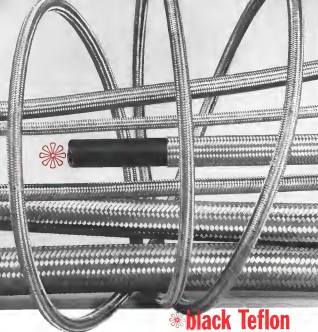
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Like the U. S. Navy's staggering 2-megawatt VLF facility at Galien, Maine, and VLF Facility in Australia, the transmitting equipment for the new NATO command communication system is being designed and produced by LTV's Continental Electronics. VLF operation in the 18-20 kc range was selected for its immunity to ionospheric disturbances and because VLF propagation follows the curvature of the earth, thus giving added range to the station. Continental is associated with Radioia, Ltd. of London on the Anthorn project.

Long recognized as the producer of the world's most powerful transmitters, Continental produced the megawatt Voice of America transmitters, the SMEWS multi-megawatt radar transmitters, and Nike-Zeus acquisition radar. Combined with Continental's activity in the fields of standard broadcast AM, RF, UHF, Single Sideband and microwave transmitters, these projects reflect another facet of LTV versatility. Continental Electronics Manufacturing Company, 4212 South Becker Blvd., Dallas 27, Texas, a subsidiary of Ling-Temco-Vought, Inc.

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The rocket-powered Northrop RP-78 is parachute recoverable. But you don't have to. It's so economical that you can forget about it. Fire missiles into it. Destroy it. It adds to the realism of the simulation. The Northrop RP-78 was designed for realism. It flies at Mach 1.3, operates at

65,000 feet, and performs evasive action by remote control throughout its entire flight. It gives perfect radar reflectivity, and attracts all operational missiles, including heat-seeking types. Is it an enemy bomber? Or the RP-78? It's hard to tell the difference. **NORTHROP VENTURA**

## EDITORIAL

### Industry Sales Problems

Last week, European Editor Cecil Bawden presented readers of this magazine with a perceptive analysis of the new type of sales problem facing U.S. firms in the international aerospace market (AW July 26, p. 56). The week before, C. R. Smith, president of American Airlines, presented this same industry with a good example of its sales problems in the domestic market when he bought 35 British Aircraft Corp. BAC 111 short-range jet transports with an option on 35 more (AW July 22, p. 32).

The lesson of both these events is that competition is getting stiffer and only more alert managements and foreign marketing technology are going to prevail against the rising tide of international competition.

After nearly two positive decades of dominating the commercial aircraft market, U.S. manufacturers are beginning to feel an increasingly sharp bite from foreign competitors. It has always amazed us to watch U.S. transport manufacturers ignore the short- and medium-range jet markets while they over-competed among themselves in the large jet market. The French Caravelle has already penetrated this market in Europe. And both American and the BAC 111 is proving attractive to airlines in many lands as they move into the second round of this type buying. The Caravelle has proved its abilities in airline service and the first BAC 111 is ready to fly, but as yet only brochures have appeared in this competition from U.S. manufacturers.

#### Twin-Jet Challenge

Stepping down a notch in the jet scale we find both British and French twin-jet executive models challenging those of U.S. manufacturers for the international market, including domestic sales. Diamond's expanding deal with Pan American World Airways for the Venture 70 will provide an excellent wedge into the U.S. market. And then there is the Swiss Pilatus Porter, in both its private and turbine-powered versions, quickly selling all over the world and winning orders from their hardened judges of aircraft efficiency the Alaskan bush pilots.

In these arenas in the U.S. design shops that will offer the equivalent of the French Regent 940 series for other military tactical transport requirements or a bush freighter for underdeveloped areas?

Several major U.S. airlines have approached Aerospace manufacturers with their need for a VTOL-type short-haul transport to serve the densely populated megalopolis that is already developing. So far, their efforts have been unsuccessful. Meanwhile, the emerging German aircraft industry is working hard on a wide variety of VTOL short-haul transport designs aimed at both military and civil requirements. Will this segment of the U.S. transport market go to the Germans by default?

The Anglo-French handwriting is already on the supersonic transport wall. The major U.S. carriers have only a few more months of grace in which to make decisions either to return the planes already blocked out for them on the Concorde production lines or to suffer a stiff competitive blow while waiting to see when and if the U.S. supersonic transport program develops into commercial hardware.

#### Military Competition Stiffens

In the military field the competition is getting even tougher. Policies, which fortunately play only an insignificant role in transport sales, loom much larger in the military sales problem. European aeronautical technology is proving out its dependence on U.S. research while that industry is working on its own generation of supersonic aircraft and the U.S. research effort is seriously hampered.

It is perhaps true that the U.S. aerospace industry has been concentrating its major effort on space technology and missile development, to the neglect of civilian aeronautics. However, we know of no major manufacturer in the aerospace business which has more business than it wants. We know of only one that has publicly declared itself out of the aircraft market, though there is some question as to how voluntary that policy may have been.

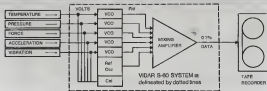
There is still an enormous amount of business in the military and commercial aircraft market around the world. If the U.S. industry doesn't shed some of its technical and management complacency soon and compete with harder drive and sharper technology, it is only kind itself grasping a dwindling share of the international market that presented so much of the reason of its success.

—Robert Hottel





Heart of the Vidar S-60 is this Vidar 210 VCO. Fifteen plug-in VCO's with associated multipliers, power supply, reference oscillator and housing are just 3 1/4" of standard 19" rack space.



## HOW TO MULTIPLEX 5 CHANNELS OF FM ANALOG DATA ON 1 TAPE TRACK WITH A SYSTEM ACCURACY OF 0.1%

Multi-channel data to be recorded in analog form has presented the instrument lab engineer with a dilemma. To achieve high accuracy, he could record one data channel per tape track. But this approach is costly because of the number of tape recorders required. The alternative of frequency multiplexing several data channels on one tape track meant a sacrifice in accuracy due to inadequate VCO performance.

The new Vidar S-60 answers the problem. This high performance data system provides 0.1% stability 0.1% linearity and solid state reliability for telemetry or FM magnetic tape storage of static and time varying data via multiplex techniques. For the first time, you can use comparatively priced VCO's to achieve 0.1% overall system accuracy!

In operation, precision voltage-controlled oscillators provide frequency-modulated sub-carrier signals at standard IRIG carrier frequencies. A highly refined

relaxation oscillator affects the voltage-to-frequency conversion.

In addition to high stability and linearity, the Vidar S-60 offers exceptional flexibility. The carrier frequency may be located anywhere within an IRIG channel. Deviation sensitivity is continuously adjustable to provide up to 30% output deviation with any selected input voltage span from 5 to 40 volts.

A plug-in sub-assembly determines the IRIG band for each VCO and includes a front panel presentation of the channel number. Front panel switches provide zero and 2.5 volt calibration from an internal reference. Output level of each VCO is adjustable from the front panel. We would be pleased to send you complete technical specifications. Please call your nearest Vidar engineering representative or write directly to Vidar Corporation, 77 Ortega Avenue, Mountain View, California, Phone: (415) 961-1000.

**VIDAR**

## WHO'S WHERE

### In the Front Office

**F. Paffy Carter**, director, **R&D** McCall Corp., San Carlos, Calif. Mr. Carter was the last president of Hughes Research Institute.

**Charles E. Smith**, associate of **Lawrence S. Recalifsky**, elected a director of **MHD Research Inc.**, Newport Beach, Calif. **Charles M. Mossey**, director vice president, **Refined**, Government Buildings, Bayport, Radio Corp. of America, Washington, D.C.

**Dr. Paul J. Lorus**, vice president, research and development, **Microelectronics**, Military Products Group, Minneapolis, Minn. Used his resignation July 25. Dr. Lorus was named Secretary of the Army for Research and Development.

**Carroll E. Bussell**, executive vice president, **H. I. Thompson Filter Glass Co.**, Gardena, Calif.

**Edward D. Campbell**, executive vice president, **Del Corp.**, Lexington, Mass. **Carl Reichenbach**, vice president, technical and electronic instruments, **Radco**, Menlo Park, Calif.

**Paul R. Mohr Jr.**, vice president, general manager, **The Polymer Corp.**, Reading, Pa.

**E. J. Kertt**, vice president, **The Aircraft Prime Co.**, Dana, Pa.

**Jack I. Hamilton**, vice president and general manager of **Goodyear**, Fort Worth, Texas and local branches of **Weston**, Mass.

**Dr. George David**, vice president research and engineering, **General Laboratories of Allied Research Associates Inc.**, Concord, Mass.

**Rae Baltes**, vice president, general manager, **Forbush, Mann & Co.**, with headquarters in Washington, D.C.

**Donald H. Block**, a vice president and general manager of **Sea, Tone Service**, Div. of **Crescent Airlines Inc.**, Arlington, Va.

**Alan Thomas I. Herb Jr.**, director of **R&D**, **Lockheed Aircraft Corp.**, Burbank, Calif., and vice president, **Wilco**, a subsidiary of **General Electric**.

**William J. Dwyer**, vice president, general manager and sales, **Adco**, Div. of **General Motors Corp.**, Detroit, Calif., and **B. E. Stone**, vice president, **Raytheon**.

**Thomas G. Hunter**, director, **Industry Planning Service**, of the **Aerospace Industries Association**, Washington, D.C.

### Honors and Elections

**James S. McDougal Jr.**, founder and chairman of **McDougal Aircraft Corp.**, has been named recipient of the 1965 Daniel Guggenheim Medal for scientific achievement in the advancement of aeronautics and space flight.

**Dr. Donald A. Bunker**, vice president and general manager of **Avco Corp.**, a Big Science Div. (San Ramon) Operations, has been temporarily assigned to the Air Force's Project Phoenix to lead the Project Phoenix Space Force.

**John D. Campbell**, manager of the Environmental Test Dept., **Palco's** MHD Div., has been elected president of the Institute of Environmental Science for 1975-76. (Continued on page 118)

## INDUSTRY OBSERVER

**Defense Dept.** is expected to continue a 4th Phase 2 development on only two elements of the mobile radar system, **Intelligence** (MIRIM) program in a month of a \$100 million study in the 5-10-10 analysis requested for Fiscal 1964 (AW Jan. 34 p. 21). These are the still-developing guidance systems at **Keelby** Div. of **General Precision** and the command and control system effort at **Martin Co.** These two elements are considered the most critical in determining overall technical feasibility of the MIRIM.

A recent Soviet article suggests the Russians are considering use of an Apollo-type Lunar Precision Module (LEM) selected from a spacecraft in lunar orbit. The article, appearing in the *Soviet Space Review*, was written by **Nikolai Voznesenskiy** and says "It would be most desirable to effect a lunar landing" by designating lunar space stations in near-earth orbit with a spacecraft becoming an artificial satellite of the moon. "A small ship would be detached from the mother ship to initiate the actual landing," later returning to the base orbiting spacecraft for the flight back to the near-earth station. A ferry vehicle would be used to return the astronauts to earth.

Computer programs representing a comprehensive planetary transportation system model for the 1975-1995 period will be developed independently by **General Dynamics/Astronautics** under a \$72,967 contract and by **Martin-Baker** under a \$74,945 contract, both from NASA's Marshall Space Flight Center. The study programs ultimately will consider such factors as distance, altitude, velocity, energy and planetary space stations and lunar, Mars, Venus, Jupiter and solar space exploration.

Attitude control system using forces generated by solar pressure has been proposed to NASA by the **Propulsion Laboratory**. In the system, a reference variable approach revealed on the side of the spacecraft over time the sun would generate a restoring force to counteract the disturbing action of solar pressure. Solar pressure torques generated for about half of the total control system had in the **Mariner 2** spacecraft.

First flight of the **General Electric/Ryan XV-5A** tilt rotor aircraft aircraft originally planned for early this month (AW Jan. 31 p. 67) has now been postponed until at least December. Attempts to cut development time by six months, made at Army's contractor, apparently is the cause for the delay.

Development of a gas-turbine optical growth for use by helicopters against ground targets is being handled by **Avco's** **Franklin Arsenal**, Philadelphia. Avco will now request for proposals to industry Aug. 6 with proposals due Sept. 26.

Technical proposals for investigation of advanced aerospace vehicle new thrust criteria used by these industry bodies in a competition sponsored by USAF's **Aeronautical Systems Div.** are due by August 15. Vehicles involved in the study will be capable of both low and high altitude flights for missions of 3 to 10 days duration respectively.

Jet Propulsion Laboratories is evaluating industry proposals for heat flux study in relation to planetary orbit solar radiation. The six-month study anticipated in the competition will consider orbital altitudes of 100 km, distances and 30,000 km, distances for both Venus and Mars.

New Zealand Ministry of Defense is shopping for light and medium tank engines for its Army use, with at least one version needed for search and rescue operations and another for training purposes. Trials are available, but the size of the order and the types have not been determined.

North American Aviation's Space and Information Systems Div.'s initial bidding for NASA under the company's contractual study for a modified Apollo logistics vehicle is scheduled for Sept. 3 and the final report due Dec. 31. Companies interested in non-funded participation in the guidance and navigation portion of the study will submit data to NASA by Aug. 15.





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...strength based on these design/development/production accomplishments at General Precision's Information Systems Group. • First digital computer to perform bombing and navigation functions in attack bombers of an operational Navy squadron. • First digital computer developed to guide an exploratory instrument package (Centaur) to a soft landing on the moon. • L-90 general-purpose digital computer, combining the fastest operating speed, lightest weight, and largest memory capacity ever developed for use in aerospace systems. • Navigation/data processing system for C-141, the first airborne military transport for global flights. • Dropsters of ECM, optics, stage separation, and thrust termination devices. • Band for Intercom Data Link (IRASCOPE) DIVISION

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PRECISION**

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## Red Chinese Rummblings

U. S. is keeping a close watch on increased Red Chinese military activity on the Indian border, in Korea and Vietnam. State Dept. thinks new Chinese activities may be an effort to increase tension in Asia, then damaging the hopeful climate created by the U. S. U. K. Soviet Sino nuclear test ban treaty (see p. 38).

U.S. reconnaissance flights over the Hsinsheng produced little evidence of a Red Chinese buildup on the Indian border, but ground reports report definite troop movements. After last fall's fighting, 200,000 Chinese troops pulled back, only 12 in 1966. Tibet. The end of the new action is approaching and these troops could be back for another invasion of the Indian border in September or October.

Red China's increasing and threatening pressure toward India, which has announced it will sign the test ban treaty, have brought Moscow and New Delhi closer together. Soviet Union has offered India special delivery of non-controlled nuclear, ground-to-air missiles, transport aircraft, helicopter and aviation artillery.

U. S. support to India may be increased, too. Indian military officials are now in the U. S. taking a close look at our military training programs, and India, the U. S. and Britain will hold combined exercises in the Delta Ganges area this fall to acquaint the Indians Air Force with the latest in supersonic aircraft operations.

## Karachi-Tokyo Route

International consortium created by Soviet-Red China left threaten to swamp Pakistan Airlines' effort to establish a Karachi-Tokyo route which would serve Canton in Shanghai. The airline selected the Red Chinese route as immediate stage after Great Britain denied it entry into Hong Kong. Soviet Union is critical at the Chinese effort to separate itself with Pakistan, and is understood to have threatened to control Pakistan service to China. On top of this, Japan, which would like to start service and expand trade with Red China, rebuffed the Pakistan bid rather than risk offending the U. S.

U. S. military airlift capability will be four times greater in 1967 than it was in 1966, Defense Secretary Robert S. McNamara said last week. He told a special House Armed Services Airlift Subpanel that substantial military supplies have been pre-positioned in Europe and the Far East, leading confidence to assure that the Defense Dept. is planning reserve resources for the year involving movements of entire divisions in both areas. Nowhere such strategic mobility exercises are planned in fiscal 1968. Building of military airlift capability will include introduction of the C-141 into Air Force inventory in 1965. The C-141 is scheduled for rollout Aug. 22 at the Lockheed-Georgia plant.

## TFX: Conflict on Conflict

Bitter dispute yet over the TFX (see p. 38) looks out on the House floor Aug. 1 when Rep. H. R. Goss (R-Iowa) rolled on President Kennedy to fire Navy Secretary Paul Kerff for conflict of interest. Rep. James C. Wright (D-Tex.) charged that Goss' remarks were "unsubstantiated" and made an emotional defense of Kerff.

Earlier, Sen. Michael L. Slattery (R-Wy.) said in a Senate speech that he was "flooded to see spelled out publicly the obvious business and political considerations which figured in Secretary Kerff's judgment on the aircraft contract." Rep. Wright also replied to Sen. Slattery's speech, charging that it was an attempt to make Kerff a scapegoat in the TFX controversy. The slattery wanted Juan Kerff's testimony that he was president of the Continental National Bank of Ft. Worth, which had loaned General Dynamics money shortly before he became Navy Secretary (AW July 25, p. 15).

## NASA Large Solids

U. S. space agency may get back the solidrocket development program it relinquished to the Air Force. Rep. George Miller (D-Calif.) chairman of the House space subcommittee, told the House when the Air Force budget was being debated Aug. 1 (see p. 17) that if the Air Force did not back its solidrocket program (AW July 5, p. 38), his committee would consider funding a NASA solidrocket development.

The fine line of the Kennedy club is solidified with announcing the Boston Electronics Research Center that it was based by the Senate space committee July 13. On Aug. 1 only six days after eliminating the \$5 million requested by NASA to start work on the center-the Senate committee voted in closed session to vision all of the funds. Previously, the House space committee cut \$1.1 million from the request and ordered NASA to prepare a new and more thorough justification for the center.

Thereby which congressional Rep. Col. John A. (Shanty) Fowles had clung to his job as "voice of Project Mercury" was finally severed last week. In recognition of his devotion to the program—once his critics asked he was a mission worker—he was named as an administrative job. He was replaced at the Mission Operations Center by Paul Bauer, Washington manager of the manned flight information program and a quiet police co-ordinator with no known addition for the program.

—Washington Staff







# NASA Technology Utilization Scrutiny Due

By Alfred P. Altissimo

Washington—U.S. space agency's much-rabaled technology utilization program—accepted "as faith" by congressional space committees this year—will be examined closely in next year's hearings to determine whether it is producing tangible benefits.

National Aeronautics and Space Administration started the program on an experimental basis in May, 1962. The agency since has created an Office of Technology Utilization under Dr. George L. Simpson, Jr., and asked for \$3.9 million in its FY1964 budget to continue the program.

Purpose of the program, according to NASA, is to "locate, research, analyze and disseminate to business and industry the useful results of NASA research and development so that the knowledge can be applied for one benefit or another."

The technology utilization program was established exactly the same by House space committees, says Roy H. Kline (D-W.Va.), chairman of the subcommittee which conducted that portion of the NASA hearings last fall, and it was difficult to determine the value of the program because it was relatively new.

"We had to accept much of the program on faith," he said. "The concept is a good one but there was no way for us to determine whether the program is doing what it is supposed to do."

Roy H. Kline and Rep. J. Edward Renshaw (D-Ill.) subcommittee members, who drafted the committee's technology utilization program, also noted that there is much in the Sea and House space committees who are skeptical of the program.

"We're fully aware of this," said Roy H. Kline. "But we believe the program has great potential. If the NASA program continued no program for technology utilization, we would have difficulty supporting it."

Rep. Hickenlooper said the committee staff would examine parts of the program "in depth," calling for private industry representatives and officials of the research organizations which are participating in the program under contract to NASA.

"We hope to make an independent determination, to find out whether the program is useful or not another home-doubt," Roy H. Kline said.

During the Hickenlooper subcommittee's hearings, some members suggested that the technology utilization program, which includes grants to research in universities and universities, was too much in the nature of a public works program and too affected from the space and aeronautics research and flight activities NASA was assigned to perform.

The subcommittee voted to recommend an authorization of \$2.5 million for the program, cutting \$1.4 million from the annual appropriation for NASA. However, while the full House space committee considered the technology utilization bill, it voted to restore the \$1 million.

"It is not yet planned," Roy H. Kline said, "and while it may happen to support the subcommittee, I was surprised."

As to the question of whether NASA is going beyond its congressional charter in technology utilization, Roy H. Kline said that the program is not a research grant program, Simpson remarks that not only is the activity within the sphere of the agency's responsibility but that the space act requires such programs. He cited three portions of the act that require:

- "The establishment of language studies of the potential benefits to be gained from the opportunities for and the problems involved in the utilization of scientific and technical activities for peaceful and warlike purposes."
- "The most effective utilization of the scientific and engineering resources of the United States."

In establishing the technology utilization program, a value was set up whereby NASA field centers and industrial contractors report to NASA head quarters technological advances that might be of interest and use in other space and non-space activities.

NASA headquarters evaluates these advances, makes value out and sends those that survive to lower research institutions for further utilization. Information on future most organizations and activities deemed worthy of further dissemination is then prepared for distribution to those who request it. That is, a firm or company making an unproved method for testing jet engines could obtain on request information on a research developed method in which the gas is liquefied and passed through fresh dried air mode.

James Dennyman, who is directly in charge of NASA's technology utilization machinery, estimates that the system has turned up about 100 innovations in advances. The most recent

summary, dated July 26, contained 90 items, which included:

- Ferroelectric electromagnetic induction ceramic sensors allow selection of chamber sizes in applications for computer networks, double drive systems, and turbine engine pressure measurement systems.
- Most efficient research process for testing metals: lowest energy requirement system that eliminates the need for a furnace, heating elements for use in vacuum conditions.
- Separated single fuel and oxidant electrochemical process.

Dennyman and that report by Mid-west Research Institute at Kansas City, which progress and benefits in innovations in industry as a whole and sections also indicate that the program already is a success. MRI has received thousands of requests for information, a high percentage of them for information on processing and materials. There are some specific subjects and numbers of requests.

Cold processing, 46 requests; forming, 33; melting back type, 27; weld metal, 25; machining, 25; composite materials, 25; electronic parts, 11; and temperature-inducing parts, 10.

A series of meetings in the Midwest at which industry organizations were required to attend 46 different technical concepts, materials or methods produced 131 responses, according to MRI, with much more interest in new processes and materials than in specific new product ideas.

MRI also reports that specific areas of application of technology in materials were of value beyond the new items. In one case, a manufacturer who had been experiencing about 25% reduction of satisfactory products was now producing, probably eliminated the backlog by using a ceramic material developed at the NASA Lewis Research Center.

Many of the recent criticisms of NASA has been over the expenditure of large sums of money by the agency for "non-commercial" studies and "public affairs" programs.

A contract with Cornell University for support of scientific studies, training and a study of NASA's public affairs activities, which would have amounted to nearly \$400,000, was canceled after a study of public affairs.

These are some of the non-commercial study contracts awarded by NASA.

University of Colorado, \$117,000 for a two-year study of the social and economic aspects of the growth of space-related science and technology in Boulder, Colo. Purpose of the study is to determine how such growth affects

population, school requirements, pollution and the general economy of a community. The administrator is to be developed by the university in consultation with other communities throughout the nation.

- Monmouth State University, \$102,515 to study the problems of states with sparse coastal resources and to determine the best use of these resources.
- Oklahoma State University, \$108,000 to study the effects of NASA programs on the regional economy.
- American Academy of Arts & Sciences, \$112,000 to study the long-range problems related to the development of NASA programs.
- Midway Research Institute, \$115,954 for a study on the short and long-term effects of space exploration on space technology on the economy of an industrial state and an analysis of the technical capabilities of these states in determining the optimum direction of future economic development.

University of Chicago, \$108,000 to report on the problems of the administration of research involving factors affecting the introduction and development of technological change in industrial organizations and the effect of technology on public affairs.

The space-commerce bill put in these studies may be necessary," said Simpson, and the emphasis on strengthening the impact of NASA programs on civil and economic conditions also has been stressed.

"Actually, these studies for the most part are related to finding out how to increase the effectiveness of our technology utilization program and providing the means for the local communities in regard to take advantage of the technology that is available from the space program."

NASA Administrator James E. Webb said last month that the technology utilization and research programs, which began fairly early for research and flight.

For the first time the U.S. has an report on technology programs of great scope which makes possible the fullest use of technological research resources. "If we do this," says the administrator, "the impact on the economy will be enormous." Webb said that the program is a study of NASA's public affairs activities, which would have amounted to nearly \$400,000, was canceled after a study of public affairs.

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population, school requirements, pollution and the general economy of a community. The administrator is to be developed by the university in consultation with other communities throughout the nation.

"The space program is completely different from defense programs in this respect," Webb said. "In these programs, the research and development is followed by production. In the space program, there is no production and no direct use of the technology. It is different. We must have a continuous technological advancement. We must not stand still and research science."

Webb and Simpson said they anticipated the Senate Act to ensure that the agency has a responsibility to help the local communities in regions understood both the opportunities available in exploring the technology developed in the space program and the economic responsibilities to participate in the program.

During the Hickenlooper subcommittee hearings, Simpson was asked if the NASA program sought to influence the government's policy on the building of research and development facilities.

"We do not go out and building

trade in the region that are 'here not' but we encourage people from the 'here not' area to participate in the program."

Another misunderstanding explained during the hearings was NASA's interest in such urban problems as pollution and waste disposal. Some members of the subcommittee suggested that even the most liberal interpretation of the Space Act would not justify the agency's participation in solving such problems.

The waste-disposal study was started in an exchange between Simpson and Rep. Renshaw, which developed the point that NASA does not attempt to find solutions but will make a study in waste disposal and help a community solve problems in solving air pollution and waste disposal.

Cited as an example on the application of scientific and technology developed by the space program was the problem of a pollution of an existing community waste disposal system.

## Jet Commander Size Increased

Weight of the Aero Commander Model 1171 Jet Commander will be increased 2,000 lb. to a total of 10,000 lb. and the fuselage will be lengthened 20 in. to a total of 50 ft. 11 in.

Changes will allow the useful load of the Jet Commander to be increased to 3,700 lb. baggage and electronics items to be moved inside the fuselage to make the aircraft more maneuverable and increase the payload.

Rate of climb will be reduced somewhat in the changes, but Commander says that it will still be able to attain an average altitude of 10,000 ft. in 10 min. and to climb to 15,000 ft. in 15 min.

Changes will also allow certification work, says manufacturer flight testing on the current prototype has been done at an altitude of between 10,000 ft. and 14,000 ft. last prototype, which was 48 ft. 11 in. of height, will remain in the next flight program at between 10,000 ft. and 14,000 ft. when it will be modified to the new length and gross weight.

Special flight prototype will be flying about Dec. 1 with the changes incorporated into it.

Additional flight, which will be limited immediately, due to the pilot compartment and its floor of the aircraft fuselage. Baggage and electronics items will be in the left side of the aircraft, facing the fuselage, which will be moved from the right side.

This will allow the two seats to be positioned in the cabin pressure, which will be a lower pressure, as pressure is planned (AWM Mar. 4, p. 10).

Engine: Model 1171 Jet Commander is located above the wing center section, will be moved below it. The fuselage will be moved from the wing center to the fuselage, which will be a wing tank.

Gross weight must be increased from 10,000 lb. to 12,000 lb. and the useful load of 3,700 lb. will be increased to 4,000 lb. This will allow the aircraft to carry 1,000 lb. of baggage and 1,000 lb. of cargo (AWM 1960 p. 1) and a 1,000 lb. remaining for crew, passengers and baggage.

The program is a crew of one and is designed to carry one crew and five passengers plus 15 lb. of baggage for each person.

Aero Commander will be operating commercially under FAA Part 135 in March, 1964, and to begin deliveries of the Jet Commander that same month.

All production testing now in place at Commander's Bedford, Ohio, production facility, and a test aircraft will be used to test the aircraft. The aircraft will be used to test the aircraft. The aircraft will be used to test the aircraft.

Recent test flights show the Jet Commander has been used in testing the Jet Commander's new standard flight deck, which will be added after the main fuselage part is added to the aircraft in showing the results down.





## Egypt Shows SA-2, Other Missiles in Parade



Great variety of missiles including some not publicly shown before, were put on view by the Egyptian government in the Cairo parade celebrating the 14th anniversary of the Nasser revolution. One new exhibit is the four-stage U.S. and anti-aircraft surface missile (above this page and bottom opposite). Range has been reported variable as very high and 400 mi. (19th July 28, p. 20). Al-Sud has reportedly been fired successfully several times over the past two months. Note polystyrene covering around neck of first stage which appears to be made of single-stage missile (top opposite page), probably one of the 800 or more missiles first shown in the parade a year ago and test fired at about the same time (19th July 30 1962, p. 20). The new form, some modifications, in World War 2 German V-2, with later modifications. Zafu missile on mobile launcher (left this page) was seen for the first time. Note flame bucket at rear of launching vehicle before launch. Zafu is an Egyptian-made missile, but mobile launcher is Russian design. Russian SA-2 Guideline two-stage anti-aircraft missile (bottom opposite page) is a radio-guided surface-to-air design with a maximum operation altitude of about 70,000 ft. (19th May 6, p. 30). Parade started first showing of the SA-2 by Egyptian. The missile is similar to the type installed at about 24 sites in Cairo during the year to the fall of 1962. One of these brought down a U.S. F-4 (12 19th May 31, p. 10). Note troops on desert combat vehicles next to Guideline carrier vehicle. For photos of aircraft displayed during the Cairo parade, see pp. 32-33.







Russian Tu-16 bomber jets jet medium bombers in Egyptian airshows are shown in fly by during parade marking 11th anniversary of Meiter revolution. Egypt has several squadrons of Tu-16s in service.

## Soviet, Messerschmitt Designs Seen in Cairo



Al Kabra advanced trainer planes, produced in Egypt under license from Hispano Aviacion S-1s, Madrid, is designated HA-180R21 in Spain. Acquired as result of collaboration of Wilk Messerschmitt with German, Swiss, American and Spanish engineers.



MI-15 fly by in Egyptian air display. Aircraft are probably C models with shrouding VK-1A turbojet of 7,170 lb static thrust and underwing fuel tanks, giving extended range of about 3,100 mi. Each wing tank adds about 137 gal to normal 440-gal load.

## Egypt Displays An-12 Freighters First Time



Antonov An-12s, military freighter versions of An-10 transport, were seen for first time in Egypt during the air display. Note guns visible in tail booms. Recently redesignated into freighter and tail designations military version from An-10.



## Walleye Weapon Plans

Initial feasibility studies for Navy's telecommanded Walleye aerial weapon will be produced by the Naval Ordnance Plant in Louisville, Ky., with subsequent product design to be conducted by BuWep's Naval Airship Facility at Indianapolis (NAF).

A production contract for the first full-scale weapon (AW July 6, p. 15) and Apr. 9, 1967, p. 11) will be placed with industry later by either NAFL or BuWep.

Walleye is expected to be used in a close support and substitution as top-ground weapon carried by high performance naval aircraft. It may be effective against both point targets from altitudes above 70,000 ft. Cruise range possibilities may be as small as 10 to 100 miles.

Now in feasibility stage of development, the approximately 1,000-lb. glide bomb will have four triangular control fins and four long, triangular fins extending about to the end of the weapon from just aft of the control surfaces.

Walleye will be guided by a single gyro-stabilized television camera which will supply necessary signals for the weapon's automatic tracking system. The pilot will observe the weapon and follow it only as target by observing images supplied by the camera and displayed at his cockpit while he is coupling from the target area. He can make course and stability corrections which will automatically feed signals to Walleye's guidance system which will command control surface movements.

Remote changes in the weapon's trajectory made by the pilot after launch may include changes in gliding or the weapon, some of the high-precision weapons cannot depend on automatic changes. Consequently, Navy is developing a device for safe timing which is not dependent on acceleration.

The probe received data back for about 14 hr. as it climbed in the open air at trajectory and then descended. It disintegrated during reentry, so distance flown covering was extrapolated. There was no attempt at recovery.

USAF generally plans to launch on other tests of the 40-ft-long four-stage, solid-propellant-impelled Blue Scout Jr. vehicles from base. Next launch, which may occur in December or January, may carry as its payload a subsonic-supersonic magnetometer to an altitude of 22,000 ft. The other payload possibility is a coherent radiation detector, which would be flown to an altitude of 50,000-100,000 ft. All Blue Scout Jr. flights from here will be full-scale probes.

Many payload possibilities are being studied by the Office of Aerospace Research and are being coordinated with National Aeronautics and Space Administration and other government agencies to avoid duplication or to cover areas of special scientific interest. Payloads will not always be new hardware designs, Air Force programs officials stressed about last week's successful flight. Overall purpose of the series will be to place instruments with an unemulated launch vehicle in selected areas of space surrounding the earth. Lt. Col. John Adams, SLM-1B (USAF designation for Blue Scout Jr.) test controller here at the Air Force Missile Test Center, said that the 15-month absence of Blue Scout from the range was attributable to the lack of quality experiments and not to the launch vehicle.

He said that Blue Scout had developed problems but said they had been solved before the last mission flight from here in April 1967.

## NASA Requests Fuel Facility, Supply Bids

Washington—Fuel requests were sent last week to 45 chemical and petroleum companies for construction of a liquid hydrogen manufacturing plant and also for supply of 78 million lb. of the propellant to National Aeronautics and Space Administration during the 54-year period beginning in April, 1965.

NASA is specifying that the storage plant be within 50 navigable miles of the Marshall Test Facility. The cost of the plant can be estimated at the contractor's discretion.

No cost estimate has been made for manufacturing and storage facilities, but NASA estimated the hydrogen will cost about \$17 million. It will be used by hydrogen-fueled engines on the Saturn and at Marshall Space Flight Center.

## Blue Scout Jr. Payload to Gather Frequency Data Above Ionosphere

Cape Canaveral—First USAF Blue Scout Jr. launch from here on 15 month left a 50-lb. payload last week to an altitude of about 100,000 ft. in a ballistic flight some 3,000 mi. down the Atlantic Missile Range.

The payload, provided by Com-

modore Research Laboratories of USAF's Office of Aerospace Research, was designed to gather data on certain ionospheric frequencies above the ionosphere and to measure the magnitude of the ionosphere. The probe carried four tuned radio frequencies (TRF) receivers, all solid state devices, covering 1.2, 2.4, 4, 6, 10, 15 and 30 mc.

The instrument 40-lb. capsule in two 30-lb. segments 180 deg. apart on the end of the probe-shaped probe, was stowed about the structure called up like a ribbon. Pre-coiled lengthwise, each antenna segment unspooled out to its full 30-lb. length after passage of the protective payload shroud and then rolled into a tubular shape.

Radio waves detected by the antennas at these frequencies were amplified, modulated and transmitted to ASMR ground stations over a 200-mc. frequency-modulated (F.M.) radio link. No attempt was made to determine range between radio noise reflected off the top of the ionosphere and noise received directly from galactic space. Knowledge is attributed to total radio energy input into the atmosphere.

Regardless of the ionosphere test to be conducted by researchers in a sounding wave generated on one of the antenna segments by a small oscillator. Variations would be a function of the electron density and energy levels surrounding the antenna. Extent of the variations also would provide data on the characteristics of the electron

## AF Capsule Recovery

Washington—Air Force last week reported that its rate of recovery of capsules ejected from space during 1962 was 79%, but a Defense Dept. release pointed the service from declining how many capsules were recovered, or how many were installed in the air as they parachuted to earth.

National Aeronautics and Space Administration's Satellite Situation Report and the United Nations report of space objects indicate that in 1962, there were 47 payloads for which recovery probably was attempted — that is, they were launched by Atlas Agena or Titan Agena, and dropped a few days after launch. Through July 15 of this year, there have been four payloads in this category.

The 65th Space Test Squadron of Hickam AFB last week received the USAF Outstanding Unit Award for developing and applying recovery techniques. This unit was back in touch with Lockheed JC-130 aircraft to recover 100-lb. document-type capsules and water-pump to recover Saturn-type capsules, weighing more than 1,000 lb.



Jack Fowler agrees with authority on ALCOA selected materials long ago.

This man can help you make forgings behave during machining





PROCESS	TEMPERATURE (°F)	ALLOY	PRODUCT (S)	TYPICAL REDUCTION FROM TS (°F)	STATUS
STRESS RELIEF (2)					
METALLURGICAL STRUTTING (STRETCHING)	7652	ALL	HAND FORGINGS (S)	95% (S)	COMMERCIAL
METALLURGICAL STRUTTING AND COMPRESSIONS	7652	ALL	HAND FORGINGS (S) DIE FORGINGS (7)	90% (S)	COMMERCIAL

NOTES: (1) The use of the T6 version of various tempers is for convenience only. The T4 or W temper is also available. (2) Processing is performed after heat treat and stretch. (3) Products, including hand forgings, including rings, die forgings and machined parts.

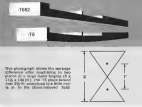
(4) Guaranteed values available on specific part drawing. (5) Except parts featured in thickness or otherwise indicated on a process. (6) Based on dimensions by users. These values represent but are not subject to variation with geometry and machining details. (7) Subject to geometry of individual part; deformation may be all stretching, all compression or a combination. Some parts cannot be effectively stress-relieved by this technique—see caption.

geometry and machining details. (7) Subject to geometry of individual part; deformation may be all stretching, all compression or a combination. Some parts cannot be effectively stress-relieved by this technique—see caption.



Jack Faulkner speaks with authority on stress-relieved aluminum forgings.

This photograph shows the warpage difference after stretching in two pieces of a large heavy forging. The top piece is a 100 lb. piece of 7652 aluminum, the bottom piece is a 100 lb. piece of 7652 aluminum. The top piece is a 100 lb. piece of 7652 aluminum, the bottom piece is a 100 lb. piece of 7652 aluminum. The top piece is a 100 lb. piece of 7652 aluminum, the bottom piece is a 100 lb. piece of 7652 aluminum.



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Residual stress built up during quenching of aluminum forgings can cause trouble later when the forgings are machined. Machining unbalances these stresses. When a lathe takes into a non-stress-relieved forging, it tends to warp, even jump out of the fixture or jig.

Little was known about stress relief until 1944, when Alcoa's Kirby Thornton first explained the principle of stretching. This method is still used on extrusions, plate and rolled shapes.

Stretching, however, proved impractical for some geometrical shapes—die and hand forgings and rolled or forged rings. But compression was found to relieve stresses just as stretching did.

Jack Faulkner, who heads the Military Equipment Section of Alcoa's Cleveland Development Division, was one of the pioneers in working with stress relief by "stretching." Today Jack offers Alcoa's customers years of experience in the complexities of this technique.

TIGHT TOLERANCES, MINIMUM WARPAGE—Compression stress relieving makes hard and die forgings behave during subsequent machining operations. For instance, Alcoa recently made a hand forging in the form of a 90°

arc of a 30-in. circle, with a cross section of 6 by 8 in. The customer had to do extensive machining, and assembly requirements called for a maximum departure from flatness and contour of .030 in. over its length of some 20 odd ft. Maximum warpage experienced during machining was .005 to .010 in.

Jack Faulkner is just one of hundreds of Alcoa's technical experts whose principal function is to help customers with metallurgical and fabricating problems. These "development men" are experienced engineers who have not only specialized in aluminum, but in specific industries. Jack, for instance, has worked almost exclusively with customers in the aerospace and military equipment industries for sixteen years. Have a problem that might involve aluminum? Just call your local Alcoa sales office. Or write Aluminum Company of America, 1968-V Alcoa Building, Pittsburgh 19, Pa.

Not an Alcoa sales office? ALCOA PROMISER  
Presented by First National City—Thompson Overton ABC-TV



## House Considers \$5.2 Billion for NASA

By Edward H. Kelson

Washington—Legislation authorizing \$5.2 billion for the U. S. space agency in Fiscal 1966 was scheduled in House debate and vote late last week after a week-long session before the House Rules Committee on July 31. The bill up for full House approval represents a \$474-million cut from the Administration's first request.

Although House space committee Chairman George P. Miller (D-Calif.) characterized the request as the "rock bottom" amount needed to keep the U. S. space effort moving, he had a difficult time convincing several members of the Rules Committee, including Chairman Howard K. Smith (D-Va.), of the need for large space expenditures.

Rep. Smith criticized Rep. Miller for the brevity of his opening statement in which he explained the bill, saying that "this is a cut statement for \$5 billion."

Rep. Smith said later, "I don't understand the scientific staff at all."

The bill authorizes National Aeronautics and Space Administration to spend \$4 billion for research and development, \$692 million for facilities construction and \$184 million for administrative operations. The only (AW) bill 12, p. 127) actually totaled \$480 million but \$15 million was added to the request in the category of facilities planning and design, for a net reduction of \$474 million.

Several members of the House space committee, despite the unfavorable reaction the bill received in the House Rules Committee, forecast favorable House action. The Rules Committee agreed to allow five hours for debate.

Rep. Smith's reaction to the bill set the stage for what was generally an unfavorable reception. The chairman said at one point that "I can't see any way of going to the moon" and when Rep. Miller tried to compare the lunar trip with the early efforts of the Wright brothers, Rep. Smith commented that when the Wright brothers were preparing for a test flight, they were "everybody in Alexandria [Va.] rejoiced then [in a pair of sniffs]."

In response to questions from Rules Committee members, Rep. Miller acknowledged the need for a space program but said he was not sure if it was a "positive activity."

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• **Cooperation and liaison between NASA and the military.** Rep. Miller said he was not sure if it was a "positive activity."

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memberships in the 1958 Space Act designed to make it harder for NASA to request and for Congress to appropriate the money which it was appropriated (AW July 15, p. 78). Finally, the agency must now give 30 days notice to the House space committee before it can modify requests totaling \$100,000 from one program to another, and no more than \$70 million can be requested during the entire fiscal year.

Finally, all the agency must do is make a commitment that it has transferred funds. After that \$200 million was transferred between agencies in fiscal 1961 money.

In summary, NASA's Fiscal 1966 authorization bill contains three main items:

• **Administrative operations—\$100 million.** Rep. Miller said he was not sure if it was a "positive activity."

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### Space Agreement

Washington—Senators have a reported agreement to sign an agreement during the week for a cooperative space program with the U. S., beginning with post-construction expenditures each next year for the Apollo 2 satellite as a positive activity.

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# New Soviet N.Y.-Moscow Route Bid Seen

By L. L. Doty

**Washington**—Possibility that the Soviet Union may make another bid for a New York-Moscow air route is growing as a result of the new assignment generated by the nuclear test ban treaty recently ratified by the U.S., Great Britain and the Soviet Union.

Meanwhile, the U.S. is showing increasing concern over the expansion of commercial airline operations in the Western Hemisphere and throughout Africa (AW Sept. 16, p. 17). Recent success of the Russian carrier, Aeroflot, in winning rights from Ghana to operate beyond Conakry to Gambia on the Moscow-Bissau run (AW July 1, p. 25) is viewed as a major step in the carrier's expansion program.

The Russians are known to be eager to enter the New York market and U.S. Secret negotiations two years ago on a bilateral air transport agreement were carried on in a basement at the airport (AW Aug. 14, 1965, p. 27). The final agreement was rejected by both sides, but was then adopted by the U.S. because of a split in relations between the two countries over the Berlin wall (AW Aug. 28, 1961, p. 79).

Although no formal move has been made, U.S. observers believe that the Russians may feel the agreement on the nuclear test ban gives them the way for negotiating air transport with the Soviet Union. Also, the U.S. will respond to such a bid to not get frozen.

The next policy an international air

transportation (AW Aug. 18, p. 14) tends to reference to relations between the U.S. and Russia. This subject is being treated separately in another study being conducted for the White House.

The Russians are now emphasizing expansion of their air routes in Africa, South America and the U.S., in that order. First point of the over-all expansion plan is Cuba.

Generally, however, the chief concern of the U.S. is Russia's recent success in strengthening its foothold in Africa.

Last year, the Russian drive for air routes in Africa appeared to have slowed down considerably. (AW Sept. 10, p. 77) but indications are now strong that the expansion program has gained renewed strength.

At present, the Russians are holding a test jet airport in Yassou, the new republic, government of that country. The U.S. is viewing that project as a key point in the pattern of Russian or later, once the new airport could serve as a jump-off point for flights to East Africa and as a link in a route across Central Africa to Congo and beyond to Latin America.

Africa currently provides Russia's main access to the Western Hemisphere, since these Western European countries that Aeroflot serve refuse to grant beyond rights to the Russian carrier. In addition, the Scandinavian countries will not give the Soviet Union transit rights, which leaves Aeroflot with only one northern route—the detour line from Murmansk, across the Bering Sea, north of Norway and Sweden.

There are other steps Russia is currently taking in hopes of reinforcing its African card on air routes.

• **Although to win beyond rights from Morocco and Algeria**, similar to those granted to Gambia, are now being made.

• **Efforts to get landing rights in Ethiopia and Somalia** is being made in order to give Aeroflot a link between the east coast of Africa. Aeroflot now lands in Kismayu, but Sudan permits only a weekend operation and has restricted Aeroflot for north-south operations.

Meanwhile, Cuba appears to have launched an expansion program for its services. At present Cuba is linked with Madrid by a route operated by Iberia. U.S. has protested to the Spaniards that government-run airlines are owned that British Canada had granted reciprocal landing rights to the Cubans. The British refusal, which is under the government of Premier Harold H. Wilson in London, and the plan embodied the apprehensions of a Communist airline and was designed to "deflect international trade."

Representative the Cuban government has of final landing rights in Venezuela, San Juan, Trinidad, Jamaica and the Dutch West Indies. Beyond the Cuban jet aircraft could serve as new routes for Cuban agents in Latin America.

At last week, the State Dept. said the U.S. was in close consultation with the British government over the relationship between Cuba and British Commonwealth.

# Pan Am Attacks Plan to Divide Transatlantic Routes With TWA

By James R. Ashlock

**Washington**—Opening of the Civil Aeronautics Board's transatlantic route renewal hearings last week was marked by a quick attack from Pan American World Airways against TWA's division of coming route between itself and Trans World Airlines.

Etha Scheff, attorney for Pan American, opposed the so-called "anti-competition" in a stiff case memorandum of John E. Pivna, and scheduled for September 10, 1965, at the CAB's hearing of common regulation.

The board has proposed the route division as a means of reducing route capacity and strengthening U.S. flag carrier competition against foreign flag carriers. Under the plan, Pan American would receive exclusive rights to certain northern European points and use its own rights into Latin America, and TWA would become the sole U.S. operator serving northern Europe and Africa.

American is favored by TWA, largely because it would provide relief from the dominance Pan American has traditionally enjoyed through being the only U.S. airline to serve 10 European cities, compared to four where TWA is exclusive.

Both Pan American and TWA would operate more business in 1964 if the anti-competition were enacted. Pivna said. Neither carrier could be expected to pick up 100% of the others' business as the exchanged route.

Pan American could expect to earn about \$150 million in revenues and TWA 140 million less than if the existing competitive situation continued through 1964. However, Pivna said that which could be reduced with removal of competitive pressures, resulting in cost savings that would mean that over the estimated \$15 million revenue loss.

Pivna said that forecasts indicate 1,440,000 persons will fly by the North Atlantic in 1964. Civilian passenger requirements, Pan American and TWA can expect to earn 18% of this volume, he said, with Pan American receiving 65% of their combined volume and TWA 45%.

Then, after 1965, no carrier is providing 44.7% of the seating capacity and moving 41.7% of the passengers. Pivna said. "In view of the major schedule changes proposed in 1964, we expect both percentages to decline."

Pivna's inference, Pivna said, that under the new concept, Pan American would pick up 90% of that business now carried by TWA to London, Frankfurt, Shannon, Bombay, Dhaka and Tel

Ave, while TWA would receive 40% of Pan American's current volume in Paris and Rome.

While TWA agrees generally with these estimates, Pan American thinks it could expect no more than 41% of TWA's current New York-London volume and 45% of its New York-Frankfurt traffic.

Pivna stressed that it is the purpose of foreign airline members that in American to reduce routes through lower fares and schedules, and frequency. Because of this, Pan American and TWA, once after reducing competitive pressures between themselves, could still have a capacity and service advantage over their foreign competitors, the board feels.

"Under the board's anti-competition," Pivna said, "we believe Pan American and TWA would be in a position to concentrate their schedules and planes on more heavily traveled routes of European gateways, with better air all world."

The board denied the anti-competition in early 1962, and Scheff's attack on it was aimed at the board that means that it does not exist.

When obtained, in his questioning, acknowledgment from Pivna that both Pan American and TWA had gained substantially in transatlantic passenger volume since 1962. Pivna said that TWA's financial position had improved TWA itself, Scheff said, was becoming \$154 million in transatlantic revenues for 1964, which was well above the \$125 million predicted for the same by the board.

Reductions in pilots, mechanics and other personnel would also result from Pan American's loss of service points, Scheff said. There is also a question with Pan American of whether the predicted cost savings under the anti-competition would cover the passenger losses, he said. Pan Am and TWA, two points Pan American would lose at this time.

## Johnson to Delta

**Delta** Air Lines last week announced the resignation of Todd G. Cole as executive vice president and chief pilot. At the same time, Delta reported that Earl D. Johnson (former president and vice chairman of the board of directors of General Dynamics) had been elected to fill the two posts.

Cole, involved in airline financial problems, has been with Delta since 1954 and was named executive vice president in 1962. Johnson resigned from General Dynamics last June.

management, account for 25% of Pan American's business in Europe.

The hearings are the first over-all examination of the transatlantic route picture in over a decade. Temporary certificates, subject to review each seven years, were awarded TWA and Pan American for operations in Europe. Recent hearings are usually held to review the certificates in order to decide if they were due, in 1974 at the end of the last seven-year interval.

The three carriers involved in the hearings, the third carrier being Swissair, would definitely vote to preserve their case. Hearings may last more than three weeks.

Pan American, aside from the economic arguments it will make against the new concept, will also stress its historical role as the first U.S. transatlantic flag airline. The fact that it proposed many of the routes now in question should provide any consideration of giving them to TWA, the carrier's officials say (AW Sept. 20).

But E. G. Cooke, senior vice president of industrial affairs for TWA, said in a letter filed with the CAB that TWA is looking to "reduce, in some measure, the imbalance which exists in favor of one principal U.S. flag competitor, Pan American."

Cooke said that TWA and Pan American disagree much of their charges and strength in competing against one another.

The anti-competition would eliminate the unnecessary competition and permit TWA and Pan American to concentrate and maintain their resources against foreign competitors," Cooke said.

Although TWA loses the anti-competition in principle, it does not meet certain marketing features of the board's plan. Cooke said. TWA's authority is terminated at Shannon, Tel Aviv and east of Rome. TWA would also be barred from transatlantic routes out of Philadelphia.

Johnson also proposed would eliminate TWA's New York and all of its undeveloped traffic potential and focus on operations of sharing the "new transatlantic market," Cooke said.

Johnson's ability to try to expand the world market gives it a substantial traffic advantage over TWA.

One point on which TWA and Pan American can be expected to join forces is in opposing Switzerland's request that it be granted passenger rights across the Atlantic.

Switzerland is proposing a non-stop 5135 service, five or six CE-440s carrying 100 passengers in space not taken up by its cargo planes. The Swiss cargo business, Switzerland said that new non-stop all-cargo business is not yet self-supporting, and additional revenue sources are needed.

## Pan American Mystery 20 Order Near

**New York**—Negotiations between Pan American World Airways and General Dynamics Aircraft Division have progressed to the stage where a final order for Pan American for 40 Mystere 20 executive jet aircraft probably will be announced this month.

Pan American will also place three lots of 40 aircraft each, bringing the total orderable order to 160 of the Pan American Mystere 20 jet.

Two General Dynamics CE-750 business jet orders will be the prepayments on the Mystere 20, which Pan American is to purchase 160 of the Mystere 20 (AW Sept. 10, p. 90) which is now being built by GE. General Dynamics will receive the third of the order from 6,000 B. More 200 B. for each engine is 1,400 B. more (1,200 B. for each engine).

Package length for the Pan American aircraft will be increased 35 in. from the present 51 ft 10 in.

Use of the General Dynamics business jet and the increased length will boost the range of the Mystere 20 to approximately 3,400 stat. mi. with reserves and standard air transport loading capacity.

Pan American officials said that if the aircraft is purchased, this will be "a key move" to operation with the airline providing another prime maintenance support.

Cooperation between the Mystere 20 for Pan American would supply their own pilots and flightline operations probably would provide maintenance facilities.

In addition, Pan American knows using the Mystere 20 for charter flights and for pilot training.

Although mentioned recently that no production plans would be formulated until a production order was in hand. But Pan American is understood to want delivery of 15 aircraft the first year and 25 the second year.



# Bid to Reverse Northeast Ruling Seen

Washington—Controversy stirred by the Civil Aeronautics Board's decision to remove Northeast Airlines from the New York-Florida market is expected to gain unprecedented strength to push for reconsideration that will be filed after the CAB issues its final order in the case.

Detail of the reversal of the Northeast operating certificate for the route has drawn a storm of criticism from the New England area, and has brought about political pressure for a switch in the decision. It is the first time in Board history that a major route has been taken away from a mainland carrier, and it is the first significant move the CAB has made toward centralization of competition on major air routes.

Although there are no signs that the CAB will reverse its decision pending issuance of a formal order, petitions for reconsideration will be given close attention and could result in a new decision if Northeast can prove the situation is an economic requirement.

Meanwhile, Northeast will take an action on the gross airline decision issued by the CAB until the formal order is rendered. CAB Chairman Allen S. Boyd last week acknowledged Northeast President James W. Aronson, saying that the action before the Board of its plans and any view it "would desire to have the Board take, in order to make the contribution of New England airspace."

The 57th decision came as a surprise to the airline's management, which had been highly optimistic that the action would return its Florida route.

Reasons for the outcome were possible, however, during the 14th day before the decision was announced. Prior to the announcement, Eastern stock rose 11 points as the New York Stock Exchange, suggesting a reaction to these

or provide an adequate level of local service in New England."

The requests argued that Northeast should be granted a subsidy for the New England routes, but added that there is a substantial need for a third carrier on the "Boswage, hourly-timed" New York-Florida market which, Miami and Memphis and it one of the largest in the world.

The decision represented agreement with findings of the CAB's economic unit, which stated that "to let one market involving nearly 2 million annual passengers for two carriers could well be considered a protected market for a few." They favored Northeast's entry into the market as a competitive point and found that Northeast had contributed substantially to strengthening air travel and to improving service on the route. They charged that limitation of the market to Northeast and Eastern was "turning back the clock" and "downgrading the needs and convenience of the traveling public." They added to that dissent.

Schulz said the well-being of Eastern undoubtedly influenced the majority decision to discontinue the route in the New York-Florida market. However, the decision is an equal blow to National which is enjoying its position as all passengers on a recently ended route from Miami to Boston.

In denying the request, Board stated that it would be inappropriate to comment on the competition question before the Board's final decision was released. He noted that the extent to which competition is necessary has been thoroughly studied and subjected to "adversity proceedings" he said.

The Board cannot overlook the fact that, as the airline, it is charged by Congress with the responsibility for determining air service patterns. The Board is under a mandate to dispose of its route proceedings as promptly as possible in order to permit the airlines to plan that it is not in a position to postpone future proceedings for the purpose stated in any decision.

Board panel members William G. Wilson and Charles G. Smith in voting to discontinue Northeast from the Florida route. Vice Chairman Robert M. Hughes and Member C. Joseph Morris also voted.

The majority found that the spirit of the proceedings show that the public benefits anticipated when the route was granted to Northeast have not materialized and that "the future prospects for operation of Northeast's service on a profitable basis are extremely remote." The majority also noted that two carriers are capable of meeting all air traffic requirements in the Florida East Coast market.

The tentative decision also calls for a restriction of Northeast's subsidy eligibility and stated that the Board will increase its full authority to manage

## USAFE Airlifts Supplies to Quake Site

Washington, Germany—U.S. Air Force Lockheed C-130 transport aircraft and jet-engineered Douglas C-124 cargo aircraft by late last week had flown to Yugoslavia previously, totaling approximately 600,000 lbs., including a full flight hospital, to aid survivors of the earthquake-wrecked city of Skopje.

Four C-130 of the U.S. Air Force in Europe (USAFE) Skopje Air Task Force (USATF) are now en route to Skopje with 10,000 lbs. of medical supplies and 5,000 lbs. of blankets. The city of Skopje was struck by the quake of 205,000 injured and 100,000 dead and taking a toll of more than 1,000 lives.

Skopje airport was not usable during the initial flights, reportedly because of damage to the runway.

Another 15 C-130s were dispatched from Rome to Belgrade base in the day after the quake on one trip, carrying a complete crop field equipment, including 120 beds, beds, tents, medical supplies and 150 doctors, technicians and nurses. Total payload was 512,000 lbs. The C-130s were en route to Skopje by a single flight carrying 20,000 lbs. of additional supplies and medical equipment. The single flight landed at Skopje.

Later in the week, the 15th Air Force from the National Military Air Transport Service (NMAC) in Germany, issued a German-Italian aid group with 75,000 lbs. of supplies from Germany to Belgrade.

## Continental Plans 1970 Service After Order for Three Concordes

Los Angeles—Continental Air Lines has become the first domestic U.S. carrier to order the Anglo-French Mach 2.2 Concorde transport.

Continental President Robert F. Sen and his company have signed an agreement with France's Air France and England's British Aircraft Corp. for the purchase of three of the 1,650-odd supersonic airplanes Continental is tentatively planning as a schedule for serving the places in service about 1970.

The three 104-passenger Concorde will cost in excess of \$50,000,000 and will be paid for substantially through revenues generated from the sale of the aircraft. Sen stated, "Actually, addition of the supersonic equipment will be far less a financial burden to Continental than the total move from jet to supersonic in 1970," he continued.

The company's equipment currently includes four Boeing 707s and five Boeing 747s. The 747s will be fully retired and the 707s will be serving the route as current procedures before the Civil Aeronautics Board. Flight time from Los Angeles to Chicago as the Concorde would be cut to 14 hr.

Continental's plans are scheduled to be reviewed after the American World Airways gets the airline's schedule which the international carrier ordered in June.

Then, Continental is the second U.S. line to order the Anglo-French Concorde, but should be the first to provide supersonic service under the United States.

In a reference to U.S. attempts to enter the supersonic aircraft field, Sen

commented that he felt there is some in local markets for both the Concorde and its bigger, faster U.S. Mach 3 transport. He stated, "The U.S. could, as suggested by the President of the United States, become the world's base for supersonic transport while the Concorde will be operated as an international transport."

Continental and terms of its contract with the manufacturers, present it from revealing what penalties it would have to pay if it should decide to terminate the contract. Before acceptance by Continental, the Concorde must be certified by the Federal Aviation Agency and meet performance guarantees.

Plans are to introduce the Concorde first on Continental's longest route—Los Angeles to Chicago—although the plan for Concorde service was not disclosed, although the company's announcement indicated that would be used on the Los Angeles-Houston route, if Continental and the 707s will be serving the route as current procedures before the Civil Aeronautics Board.

Flight time from Los Angeles to Chicago as the Concorde would be cut to 14 hr. Continental will schedule with American and other major Continental route segments as Los Angeles-Kansas City and Los Angeles-Houston.

Sen said that Concorde are expected to be able to operate at sea level and at or below 30,000 ft. on various points over our present routes, "and will also, obviously, enhance Continental's profit position in the 1970s."

## Acroflot Introducing An-24 on Local Routes

Moscow—For the last time in December 1969, Russia's long-neglected local airline passenger this summer is being offered quality service comparable to that of the mainline airlines.

In the past, Aeroflot's local lines have been served either by hand-engineered transport from truck routes or by slow, low-capacity lightplanes. As the new transport, Aeroflot An-24 (AN-24) June 5, p. 40, designed to operate from unpaved airports, is beginning to take over short-haul routes from routes that obsolete and obsolescent L-41 (Russian version of the DC-11) and L-410.

Besides providing better passenger service, Aeroflot believes that the An-24 will reduce local airline deficits substantially.

First-line operating costs for the An-24 are expected to be 25-30% below those for the two-engine, piston-powered Ilyushin Il-14, which Aeroflot's last transport in local service.

One major advantage of the An-24 is its ability, because of improved undercarriage design and lower pressure tires, to operate from softer unpaved runways than the Il-14. Aeroflot estimates that this characteristic will enable An-24s to "reduce by 15-15% the number of times each aircraft, left alone at most 'leaf' Russian airports, cannot be used because of wet weather, as compared with 14-16 times necessary requirements.

Aeroflot expects to cut costs further by selling the use of An-24 cockpit crews. As soon as the craft have been "authorized" in scheduled service, they will carry only a pilot and copilot. Flight radio operators and flight maintenance personnel will be eliminated by Aeroflot.

Il-14s and Il-16s carry at least five men on the cockpit-two pilots, navigator, radio operator and mechanic—plus a fourth man trying to reduce costs on these planes.

As 24 seats, 44 passengers, compared with 36 for the high density version of the Il-14. Aeroflot initially sought the An-24 in 1967 for An-24s in 500 for the Il-14.

Block-to-block speed for An-24s, 497-559 mph, according to manufacturer's data, is 25% mph, compared with 198 mph for the Il-14. Aeroflot An-24 top speed at maximum altitude is 310 mph against 256 mph for the Il-14.

Average An-24 cruising altitude is 19,000 ft. The Il-14 cruises at 5,555, 5,545 ft.

Aeroflot places that An-24s can operate from all airports presently used by Il-14s. Takeoff run for both craft is listed at 1,640 ft.

## Subaru 1962 Losses

French-Swiss Belgian World Air line, last reported 1962 losses of \$2,000,000, 50% of which are accounted for by depreciation charges computed with the 1962 depreciation of \$13.7 million. The loss is being covered by a convertible Belgian government loan.

Revenue during 1962, Subaru's 40th year of operation, totaled \$75 million, \$14 million more than the 1961 total of \$71.7 million.

Passenger revenue increased from \$15,114 in 1961 to \$15,578 in 1962, 4,740 more than the airline's best year before.

Total freight transported fell by 11%, however, and was responsible for a decline in the company's operating loss from \$14.7 million in 1961 to \$10.7 million in 1962. Total operating revenue was 281,705, 900 ton miles, as opposed to 124,601, 775 ton miles sold, resulting in an increase of 62% and 64%, respectively, over 1961.

## Grand Commander

Several local news stories have been published about the Grand Commander, a new aircraft to be built in the near future in the United States.

The new aircraft is a result of continuing the growth of fixed-wing or rotary-wing aircraft.

Local interest in this aircraft is the Grand Commander or Airplane and Airline Southern Airways also may be interested. Air Commander does not expect to have production as an 11-passenger version of the Grand Commander before 1970, as there is no sign of the current development.

Four Grand Commander aircraft have been ordered by airlines, two by Ron Aueron of Rexford, N.M., and two by Frederickson Airlines of Phoenix, Ariz.





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## American President Urges SST Action

New York-American Airlines President C. R. Smith last week urged the U.S. to get moving on development of a Mach 2.4 to 2.5 supersonic transport prototype with a Mach 3 growth capability.

Smith and industry should enter its efforts around development of a non-transport prototype costing about \$300 million. The alternative, Smith said, is a \$1 billion development program which undoubtedly would encounter congressional opposition. Smith and the prototype program could attract most of the technical problems involved with a supersonic transport.

Smith's timetable for a Mach 2.4 aircraft with growth potential as contractor proposals to be submitted by January, 1965, government evaluation to be completed and prototype contract award in March 1965, first flight by Dec. 30, 1966, preliminary flight evaluation to be completed by April, 1967, final decision on service selection by June, 1967, Federal Aviation Agency certification by December, 1971, including possibly eight deliveries that year, and production and delivery of 12 to 15 aircraft per year beginning in 1973.

Smith and talks with manufacturers have indicated that such a schedule is possible.

Government's role would be to administer the prototype contract, Smith said, with further participation to be held in a minimum. Manufacturers would have the major role in design and selection of equipment. Smith said the FAA would appoint Gordon H. Bain, the FAA assistant administrator for aerospace, as a new post to deputy administrator for supersonic transport development. His job is to coordinate government safety efforts.

## New York Control Center Burden May Curtail Traffic After 1968

By Ward Wingle

New York-New York's growing air traffic burden, already straining the area's Air Route Traffic Control Center for an average of four hours per day, may leave the city to train every traffic after 1965 until a fourth metropolitan airport is built.

The report was voiced by Oscar Bell, assistant administrator, Federal Aviation Agency's eastern region, at a recent presentation of New York's air traffic problem with an emphasis on Idlewild Airport.

### FAA Study

Bell's remarks were backed by the results of an extensive FAA study of air traffic at the New York area for one day—Friday, June 5.

Results of the study for that day included these facts:

- **Aircraft handled.** New York Air Route Traffic Control Center handled a total of 5,008 IFR contacts including overflights compared with a normal daily average of 3,800 and a seasonal peak of about 4,000 contacts.

- **Arrivals and Departures.** Between 5 and 7 p.m. EDT, IFR flights of 1,610 would total 50 arrivals and 45 departures. VFR flights totaled 12 arrivals and 12 departures in addition to 13 helicopter trips.

During the same period, La Guardia showed a total of 35 IFR arrivals and 34 departures. VFR flights totaled 12

arrivals and 16 departures in addition to 10 helicopter flights.

- **Delays.** Average arrival delay between 5 and 7 p.m. at Idlewild ranged from 8 to 42 min. with an average delay of 25 min. Departure delay ranged from a maximum of 17 min. to a minimum of 1 to 27 min. with an average delay of 1 to 20 min.

Arrival delays at La Guardia ranged from 7 to 29 min. with an average delay of 15.7 min. Departure delays ranged from 0 to 1 hr. 34 min. with an average delay of 39.3 min.

Newark arrival delays ranged from 0 to 3 min. with an insignificant average and departure delays ranged from 0 to 1 hr. 7 min. with an average delay of 41.4 min.

- **Traffic load per controller.** From 4 to 6 p.m. traffic in each of the New York metropolitan area's five principal traffic control sectors ranged above the 15 arrivals per hour maximum allowed each controller as a guide in staffing a sector. Each sector is staffed by two controllers.

Traffic per controller, between these hours, ranged from a low of 15 contacts at the Dover-Fox-Rosebud sector to 27 contacts at Solberg sector.

Average number of contacts from 10 a.m. to midnight ranged from a low of 13 at Citi's Neck and Deer Park

sectors to a high of 22 at Poughkeepsie.

Contributing factors to the normally high June 7 traffic load, Bell said, were college and weekend vacations coupled with a marginal VFR conditions which were thought to discourage business flying. Nevertheless, FAA officials feel the June 7 peak is indicative of a trend that will eventually limit the influx of aircraft into the New York area.

### Current Plans

Present plans for relief of New York's shrinking air space center around construction of a fourth airport well outside the traffic patterns of the present metropolitan terminals.

Part of New York Authority, a bi-state agency operating New York's metropolitan airports, estimates that it would take seven to ten years to complete a new airport if it were begun today. This could mean a period of one or more years of restricted aircraft scheduling beginning about 1968 until the new metropolitan airport reaches its completion.

Decisions on a site for a fourth airport dated since 1961, a still stalled Port Authority, whose original proposal calling for a fourth airport near Monticello, N. Y., was rejected by that state, has been ordered by the governors of both states to seriously study at Basking Ridge, N. J., and Free Island, N. Y. and submit a new report on the site in 60 to 90 days.

The Burlington site, below Tuxedo and Bordentown, N. J., is over 65 air miles from Manhattan and the Free Island site is over 40 mi. As present, no one has any clear idea of how to bring potential new routes into existing mid-air traffic. On account of the new Port Authority report, the government can choose one site or the other or tell the authority to come up with another proposal.

### Other Proposal

One other proposal, Raritan Bay below Staten Island—about 25 air miles from city center—appears to have been officially killed. Austin J. Tobin, executive director of the Port Authority, told the meeting that air traffic patterns from existing airports "make this site completely unfeasible from the standpoint of existing air space."

Raritan Bay would have required the use of filled land, which was not considered a major engineering stumbling block at the project.

If either the Free Island or the Burlington sites were chosen, a up-state in the future, airport would be necessary to give Port Authority jurisdiction over the airport—a step that would require state legislation.



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MIAMI INTERNATIONAL'S double-deck parking system is visible in aerial photograph. Center portion of terminal building is seven stories high, contains hotel and airport offices. Tall-gate international finger is one center of terminal. Location of new Station Air Lines and Pan American World Airways terminal units at right of Runway 17R-9L at top of picture.

### Major U. S. Airports—Part 7:

## Atlanta, Miami Share Concepts, Problems

By Robert H. Cook

Atlanta-Atlanta Municipal and Miami International airports share common beliefs and problems in their role as the two largest air traffic hubs in the U. S. Southeast.

Both are staunch advocates of the "finger" design concept and each handles an almost equal number of airline passengers. Last year, the Atlanta facility handled 41 million passengers and Miami handled 42 million. "There is no reason to doubt that long walking distances for passengers reduce that all over airport with a similar continued design—there is no more potential added in handling high volumes of airline traffic [AWF Page 7, p. 45].

### Walking Distance

Walking distances from ticket counters to boarding gates can be as much as 1,000-2,000 ft in Atlanta's single wing design of six fingers, and nearly that distance at Miami's six fingers, which radiate outward from the 2,100-ft long terminal building. A recent study of such one-half mile is possible for the connecting airline passengers at each terminal, and here again the airports have concluded that the small percentage of such passengers does not justify concern.

However, a surprising amount of ramp traffic at both airports consists of airline VFR craft, including the near or better-known passengers in connecting flights. Officials at both airports, therefore, hint that it might lighten their complaint files if the airlines would reveal the number of this service in a larger segment of the public.

The city of Atlanta focuses these problems nearly eight years ago when it considered building a mobile lounge facility. As in the case of Chicago's O'Hare International Airport (AWF July 13, p. 49), the idea was rejected by the airlines, which objected that the design would not permit enough area for operations offices and equipment storage. A circular design located with fingers was also considered but rejected in favor of the present design, which requires a half-hour transfer time of 20 min between flight schedules.

With 13 gate positions, the cost of a moving sidewalk through the fingers would be prohibitive, and the airport has also abandoned the idea of electric cart transport on the fingers after a brief experiment two years ago. Carts were used in the fingers over a five-month period with a "limited" working day. The idea was dropped because of lack of passenger, Atlanta airport officials say.

One probable reason for passenger complaints about Atlanta Municipal is that over-scheduling of flights has been a long-term problem. The airport now handles about 750,000 passengers a month and has experienced loading delays of up to 30 min, and on one occasion a total of 27 flights were scheduled to land at the same time. The several airlines, the Federal Aviation Agency has been placing all scheduled aircraft within a 10 min radius of the airport under current radar surveillance.

### Parallel Runway

The only way to solve this problem, Atlanta feels, is to approve a parallel runway, which would permit simultaneous landing and takeoff, depending on the airport's present operations, after an estimated \$75 million cost. The runway would parallel the airport's fifth instrumented Runway 9-27.

However, there are problems with both the FAA and the residents of Clayton County, on which half of the airport property is located. Atlanta's city charter forbids the purchase of such land unless it is for "immediate governmental use." Clayton County already owns 10,000 ac in, among the full project, who has a \$10 million for the full \$5 million against the airport.





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(But only once in 3,000 8-hour flights)

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the flight, (in our tests, 8 hours) "m" is the mean time-between-failure of 422 hours\* for Collins single Doppler. To find out how dual Doppler will perform on your route, substitute your route flying time for "x."

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\*Based on users' calculations

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**LONG-RANGE VIEW** of Atlanta Municipal Airport shows layout of major design and proximity to the runway system. Area at upper left is portion of old terminal center, now used to accommodate cargo and general aviation operations.

have been opposing the new runway proposal. About 155 acres of land and 500 homes would be involved in the purchase.

As it is now planned, there would be a minimum separation between the centers of only 4,400 ft., as opposed to FAA's own standards requiring a minimum of 5,000 ft.

#### Atlanta Alternative

If FAA rejects this recommendation, Atlanta will have to push further into DeKalb County, facing the problem of even greater resistance from the residents and higher purchase costs. But first it needs FAA approval to angle around the city's famous "crescent city" slough.

Meanwhile the airport is changing the grade on Runway 13R and plans a 1,500-ft. extension to give it a total length of 7,000 ft.

Last week, the airport earned a net operating profit of \$11.9 million, and after principal and interest payments on bonded notes, recorded a surplus of \$542,000.

With an expansion program in mind, Atlanta has rebid the airlines that it intends to negotiate for higher landing fees.

The present landing fee for jumbo jets has been in effect for 32 years and still has 37 cents to run.

Miami International has at least two distinct advantages over Atlanta in the area of passenger convenience.

Separate terminal and baggage facilities are located at the beginning of each flight, and remote sleeping facilities are duplicated at scattered intervals throughout the vast terminal building. Its old 19th a 270-room hotel has been designed as a part of the terminal building at the airport.

One of the most persistent airline complaints in the past was that the airport's taxiway design was not so conditioned. There have now been no complaints to include an overbuilding, and the balance will be finished by the end of this year. The design used by Eastern Air Lines is being redesigned and added to one across existing bridges and a \$2-million project is under way to improve the international bridge. The airport has a total of 74 gate positions. International passenger movement for nearly 21% of Miami International's total passenger volume last year.

With a high percentage of western air, the airport is also benefiting from its Airport Expressway, which has cut ground travel time to Miami Beach hotels to about 10 min.

#### Four Runways

Miami International has four well-equipped runways, including two parallel runways, which it feels will be adequate to handle future traffic growth. About 51% of the total traffic is handled by the 10,000-ft. Runway 17R-9L and its 9,710-ft. parallel, 5R-27L, both of which are east-west runways. The other two runways oriented on a general north-south and northeast-southwest direction are the 8,400-ft. Runway 30-12 and Runway 35-17, which is 6,200 ft. long.

Eastern has completed a new \$36 million jet maintenance base on the airport and Pan American World Airways will complete a similar \$5 million project involving an office building below the end of this year. Site of the new projects is on the north side of the airport property formerly occupied by the old 360-ft. Terminal. Construction of the Eastern project was

financed through a Dade County Port Authority bond issue, secured by Eastern's signing of a 10-year lease on the property.

It has been estimated that these two airlines, along with Delta and National, have a total investment of more than \$150 million in the airport. Present landing fee charges are not levied against these carriers, and the airport has been attempting to negotiate a new fee schedule. The present schedule is effective through 1966.

#### Preferential Takeoffs

As with most large air terminals, Miami has instituted a system of preferential runway takeoffs to meet some complaints. It has also reduced all morning flights and shifted evening takeoffs to the new late and early hours. General procedure is to direct departing flights to such an altitude of 3,000 ft. and distance of 5 mi. over the ocean before turning to cross the city proper at reduced power settings.

The airport reports that it has no current major complaints on the new problems from surrounding communities. The city of Miami has cooperated in moving land in the airport area and complaints from the Miami Beach area dropped after its extensive traffic program conducted by the Port Authority. Most thrust of the campaign, pushed up and supported by the newspaper and television media, emphasized the dollar value of its contribution to the Miami area and the need to provide a measure of safety for the entire peninsula.

(The eighth and final article in this series will be a report on Delta International Airport. It will appear as a subsequent issue of Aviation Week & Space Technology.)



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## AIRLINE OBSERVER

►Charters are strong that the next order for the BAC 111 twin jet transport will be placed by Western Air Lines, which may have up to 38 aircraft powered by the Rolls-Royce Spey turbo engine.

►Watch for American Airlines to move into the Washington-New York Boston corridor shortly after Eastern. During Aerospace/Defense security hearings, American told there was room for only one charter operator in this market, and indicated that if the airport came about, the consolidated carrier would place Lockheed Electra turboprop transports in the operation. American's expected move is one designed to determine which carrier—American or Eastern—will be the only shuttle operator.

►Tied toward one of U.S. carriers by American tourists is continuing on North Atlantic routes (AW June 3, p. 30). Both TWA and Pan American have become established as top-ranking carriers in the market.

►Boeing's decision to order three Douglas DC-8 short-range jetliners for turboprop, following Civil Aeronautics Board's rejection of the carrier's order for three BAC 111 jet transports, is forcing CAA to make a policy decision. Disapproval of the DC-8 purchase could mean the Board is opposed to the operation of jet transports by a subsidized local service carrier. However, the Board's production order for those carriers that need a government-subsidized line to purchase the planes. That any policy, applied in explicit, against the use of jets in local service operations will not be alienating and could create a competitive imbalance in some areas.

►International Air Transport Association conference, scheduled for Sept. 7 in Salzburg, Austria (AW July 28, p. 38), is now expected to be a composite meeting, culminating all regions. Special meeting was originally called to compromise differences over two strategies established for the North Atlantic air line's composite conference in Chaudhry, Air (AW Nov. 5, p. 14).

►United Air Lines will apply the TAKAN-test and replace as necessary—principle to the maintenance of aircraft hydraulic system components. Under the system, hydraulic components will be tested during overhaul periods and replaced when they fail to meet test specifications. Current practice calls for the replacement of each part to a specific TBO—time between overhauls.

►Domestic truck carriers and U.S. airports scheduled airlines have 60 million ton miles of air cargo during the first six months of 1963, an 8.1% increase over the same period last year according to the Air Transport Association. Air freight increased 9.5%, air express 2.2% and air mail rose 6.7%.

►Boeing's Aircraft Division 1959 model passengers and 8% more cargo during the first half of 1963 than in the same 1962 period. But the Boeing order is still falling short of its traffic goals. A 19% passenger gain, if maintained during all of 1963, would bring Boeing's total for the year to about 32 aircraft, compared with 27 aircraft in 1962. However, Boeing's goal for 1963 is 35 aircraft shipments. During the first half of 1963, Boeing had 2,293 gain in passengers and a 9% increase in cargo over the same 1962 period.

►TWA World Airlines pilots will seek a reduction in monthly flight time requirements when negotiations open in a new contract. Current contract expires in November. However, TWA's pilots are not expected to offer abandonment of the commercial and instrument rating for flight engineers in exchange for the lower flight time, as was done by American Airlines pilots. TWA is still giving pilot training in response to requests by the existing contract, with 120 additional holding pilot rating and 175 expected to receive ratings in 1963. Some among TWA's 1,405 pilots had flown the American pilots' formula, in which flight time was reduced from 55 to 75 hr monthly. But as Airline Pilots Association poll of TWA revealed that of 910 votes cast, 731 favored retaining the current one complicated conditions and keeping them separate from any move to gain lower flight time.

## SHORTLINES

►Allstate Airlines has reported a 14% increase in the number of passengers carried and an 11% rise in revenue passenger miles for the first six months of 1963, compared with the first half of 1962. The cargo handled increased 14%.

►American Society of Travel Agents' 31st World Travel Congress in October at Mexico City will be attended by George Zerkow and Vladimir L. Babitsky of Russia's Institute Civil Aeronautics Board Chairman Alan B. Reed will be the keynote speaker.

►Boeing Airways will expand its electronic navigation system in January when 92 new electronic agent locations in eight cities will be fed by direct lines to the central data processor in Dallas. Contract for the installation was awarded to Telegraph Corp.

►Capital Airlines will take delivery of its Douglas DC-8F convertible jet cargo-cargo jet transport in August and will place it in service in September.

►Cathay Pacific Airways has started direct air service between Hong Kong and Jerusalem, North Borneo. An additional weekly schedule to North Borneo from Hong Kong has been operated by the airline through Manila.

►Eastern Air Lines will convert its 39 Lockheed Electra turboprop transports from all Electra to a dual-conversion bus coach and electric seating in September. Forward conversion will total 15 aircraft and 74 seats will be installed after the final conversion.

►Federal Aviation Agency has now awarded a \$3.5 million contract to Raytheon Corp. for the development of a radar video data processor system (RVDP) for installation at long- and short-range radar locations. RVDP is expected to eliminate need for separate radar transmitter and receiver in cities and used to transmit data from radar sites to control centers.

►Shick Corp. has reported a net loss of \$24,256 for the last six months of 1963 compared with a net income of \$718,714 in the same period last year. Revenue rose sharply in the second quarter, when a profit was shown, due to increased business of the Shick Airways Div., which, according to the company, was adversely affected in the early months of 1963 by a drop in military contract business.

## MISSILES & SPACE

Boeing transportation missile had made up and had now completed primary development testing, an agreement was made for a 100th BOMARC, TRIM, CONTAIN, is a first month, and so.

## CONVAIR F-106

Boeing has been awarded a contract for the development of a new Lockheed. The contract is for the development of a new Lockheed. The contract is for the development of a new Lockheed.

## LOCKHEED C-141

Lockheed of Lockheed will be fitted with several new weapons are loading gun doors and electronic and doors manufactured by Beech.



## McDONNELL PHANTOM II

Includes wing sections, speed brakes, systems, landing gear doors, and nose gear doors, made by Beech.



## CONVAIR F-106

Boeing has been awarded a contract for the development of a new Lockheed. The contract is for the development of a new Lockheed.

## REPUBLIC F-105

Thunderbolt aircraft are in development by Beechcraft.



## McDONNELL F-101

Jet fighter has been made complete, including the wing, tail, and fuselage.



## BELL UH-1D

Boeing helicopter has many modifications, including rotor blades by Beech.



## LOCKHEED F-104

Starfighter airframe and engine tests are made by Beech.



## Why do so many leaders choose Beech?

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Not one of these reasons should be called "Beechcraft." Yet each has one or more Beech components. The longest prime contractor in position and experience is responsible to Beech. Why?

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conventional methods. Beech's metal bending facilities and capabilities are outstanding.

Another reason for choosing Beech is its approach to design. Beech's design process is both efficient and rapid. People at Beech call this "Beechcraft" and they are proud of it.

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## RAYTHEON... a leader in radar for space vehicles

Top illustrations (left to right): Landing, Rendezvous, Docking.

Left: Raytheon's Prototype Rendezvous Radar installed in the Martin Marietta Company's Closure Test and Training Facility.

Raytheon — leading designer and manufacturer for ground-based, aircraft, and missile systems — has developed and is testing prototype space radars for RENDEZVOUS . . . DOCKING . . . LANDING.

Currently being explored under Raytheon's in-house space radar program are several interesting configurations. One of these, the Raytheon Rendezvous Radar, has been installed in the Martin Marietta Company's Closure Test and Training Facility at Denver, Colorado. It is applicable to such systems as Apollo, Lunar

Logistics System, Mars Excursion or Command Module, Satellite Inspectors, and Manized Space Stations. Variations of the system are now being tested for particular missions.

For additional information — or a discussion of how the same Raytheon integrated system capability can be applied to your requirements — contact Neil A. Martone, Director, Marketing, Space and Information Systems Division, Raytheon Company, Bedford, Massachusetts.

**RAYTHEON**





Dassault Mystere 20, powered by Pratt & Whitney JT12A-6, in right-pancage configuration, has maximum takeoff weight of 29,210 lb.



## Mystere 20 Performance Demonstrated

Dassault Mystere 20 executive jet, which made its first public appearance at the recent Paris Air Show, is aimed at a wide international market. U. S. version will offer engine and accessory options to be produced in this country. The prototype, shown here in demonstration flight at Paris Air Show, is powered by Pratt & Whitney JT12A-6 turbojets of 3,500 lb. thrust each. Various two British contractors will offer option of Bristol Siddeley Viper 23 engines. Future performance and range may be boosted by adoption of turbofans, possibly the General Electric CF700 or its. Maximum cruise with JT12A-6 is quoted as 512 mph at 30,000 ft.



Normal replacement shown on Dassault Mystere 20 doesn't sold in the U. S. will be almost wholly American made, Dassault says.



Landing distance for the Mystere 20 is given as 2,624 ft. for either the Pratt & Whitney- or Bristol Siddeley-powered version. Approach speed for both is 140 kt. Maximum range with IFR reserves for either aircraft is quoted as 3,365 mi.







CONICAL LIFTING BODY model developed by Flight Research Center is a 100-lb. glider model of the M2 lifting body under study.

## NASA Focuses on Three Aircraft Areas

By Edward H. Kelen

Washington—Character of the U. S. aeronautical research program is changing to reflect the dwindling number of aircraft under development, but the National Aeronautics and Space Administration feels it is laying its full research resources to the aircraft programs that have been defined as well as those of the future.

NASA's overall aeronautical research funding has dropped from \$90 million five years ago to \$16.2 million for fiscal 1964, a factor which has brought in cutting programs that the agency is focusing on little to aircraft research because of its preoccupation with space programs.

The problem, according to Dr. Hugh L. Dryden, deputy NASA administrator, is that "last year's new aircraft are being developed. Some feel that NASA can produce a large class of new aircraft and get the (aeronautical) industry on the way. But research will not be as strong over as long as so few aircraft are being built."

To ensure that activities, NASA held a research seminar recently to explain that it is focusing research largely on three programs—the supersonic transport, hypersonic research aircraft

and vertical/short takeoff and landing aircraft—as well as looking for new ideas in the basic information storehouse for aircraft programs that may evolve in the future.

Highlight of the seminar was the agency's review of its supersonic transport research. The conclusion that can be drawn from the review is that the agency feels it is able to take a small larger role in the supersonic transport development program—probably to the

same degree as in the X-15 program, where NASA is technical manager.

Federal Aviation Agency is overall manager of the supersonic transport program, with NASA the technical consultant. Dr. Raymond L. Bagnall, director of NASA's advanced research and technology, and the agency is proposed to spend more on this effort if Congress approves the President's request for \$66 million in supplemental funds to start the program starting (AW Feb. 1, p. 30). A total of \$4.8 million has been allocated for supersonic transport research in NASA's fiscal 1964 request, but the agency feels it has now isolated the critical problems associated with the aircraft and is ready to commit more money to the work of solving them. These problems are in the areas of the engine, structural strength and aerodynamic heating.

Charles H. Zimmerman, director of aircraft technical research and NASA would like to have two competing supersonic transport types under development through primitive contractors. James E. Webb, NASA administrator, and NASA is on the way toward having a test aircraft capable of Mach 3 speed. Langley Research Center will be host to an industry conference on the supersonic transport Sept. 17 and 18 (AW

July 28, p. 37), when NASA will release the results of configuration studies being made by Boeing and Lockheed (AW Apr. 1, p. 33) as well as the various research under way.

Other aviation highlights were:

- Hypersonic aircraft have a wide variety of potential uses, according to Laurence K. Loftis, Jr., assistant director at Langley, with the greatest potential in an orbital supply system and in very high speed transportation between points on the earth.

He identified as key hypersonic aircraft research problems: very high performance aircraft able to operate over the entire speed range efficiently; variable geometry hypersonic inlets and exits; advancement in structures and materials and the standard aerodynamic problem of low drag with high lift-to-drag ratio configurations.

Dr. De R. Best, assistant director of Flight Research Center, briefly described a hypersonic research aircraft (HRA) capable of flying in the Mach 8 to 10 range that could be the next generation of experimental aircraft.

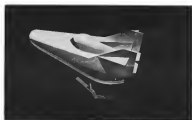
- X-15 (manned) exploratory program is currently has been completed, but the aircraft can be modified for use as a hypersonic cruise vehicle testing platform.
- Dr. Berler and Verner materials can be placed on the X-15 structure, and the aircraft can carry hydrogen fuel engines able for testing.

- Vertical and short takeoff and landing (V/STOL) aircraft research covers a broad area in NASA, but considerable research remains to be done—especially in the area of operating problems—to bring this aircraft type into an operational status, according to John F. Reeder of Langley.

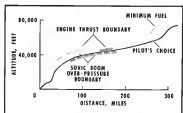
Reeder said helicopters were the first and still are the only true V/STOL aircraft. A promising avenue to improving the helicopter, he said, lies in the use of the Langley rotor, which will provide much better stability and control, reduce drag and improve the lift-to-drag ratio. Another element in the new rotor is to handle large counter-rotating shafts for operating on a sloping terrain.

In addition to improving the inherent speed and range of the helicopter, the center and V/STOL aircraft, NASA is studying a wide range of possibilities in V/STOL, says Reeder said, but he pointed out that "the earliest aircraft available, those for long term development for a realistic study of V/STOL operating problems." NASA has and the Bell XV-3, Vortec V-2, Ryan V-8, Deak V-2, Bell X-14 and Can-Am Wright X-14B for advanced flight testing of V/STOL concepts.

In addition, the agency participated in the engineering evaluation of the British Hawker P-1127 and trained Hawker pilots with the X-14. NASA is now conducting wind tunnel and free



NAMED WINDLESS VEHICLE is shown in what's concept working down on landing sled.



OPTIMUM and PILOT'S CHOICE flight paths for 153 class schedule are shown on graph. Pilot choice line, developed through simulation, meets results in excessive fuel consumption. Takeoff thrust and acceleration phase ends about one-third of the fuel load.

flight studies of models of the three classes using X-15 and the Bell X-17 with flight research planned for both vehicles, Reeder said.

Mark R. Nichols of Langley, reviewed the NASA supersonic transport technical effort, and he pointed out that flight efficiency at higher Mach numbers is limited basically by the increase in surface temperature.

Materials property studies have shown that the thermal strength decreases for aluminum alloys above 3000 degrees at velocities above Mach 2, and these alloys tend to exceed when exposed to high speeds for long times. Transpiration at Mach 5 is about 1000°.

Some basic experiments is the only critical operating problem introduced by the supersonic transport which other aeronautical transports do not have to face, Nichols said. However, the most even more critical the gross drag-

ing energy and lift-to-drag lift paths the aircraft must fly to avoid the other problems exceeding maximum life and altitude, in cooling factor, gust and fuel jet regions, and firing surface temperature and strength design limits.

Nichols said the transport should be designed to use under 2.5 lb./ft<sup>3</sup> for some basic experiments, and Reeder H. Hubbard, also of Langley, discussed the research under way to better understand the sonic boom phenomenon.

Flight tests, wind tunnel configuration studies and analytical studies of atmospheric propagation are under way, Hubbard said, to obtain an understanding of the way in which booms can be generated, propagated and predicted. These studies are aimed at reducing the effects of booms on personnel in flight aircraft, building structures, ground stations and communities.

In his review of hypersonic aircraft





**ADVANCED RESEARCH AIDS** for X-15 would be applicable to hypersonic cruise vehicles. Fuel nozzles could be tested for a variety of shapes, with air-breathing propulsion systems tested under the conditions, as indicated in the drawing.

research, Loftis pointed out that such a vehicle would require a great choice of maneuvering launch window and of landing and takeoff locations for an orbital supply system. In addition, it would be both assembleable and disassembleable.

Loftis considered that an hypersonic cruise vehicle is possible, but that such a system—either air-breathing or a combination of rocket and air-breathing stages—is more attractive than a single stage. He also estimated that both weights and costs will be high in such a system.

A plan is being developed now to test a hypersonic transport up to velocities of 16,000 mph, by launching it at the preheated air in a shooting boat. The Soviet launch is not yet in approved

project, but an approved plan is to test transport systems in four months for speeds, up to Mach 11, scale effects, cold operations and hot operations.

One of the basic questions of a hypersonic aircraft is the environment in which it will operate. Loftis said. The environment will result in a 4,000° heat load on the nose, 1,000° on the leading edges, 2,500° on the lower surface and 1,100° on the upper surface. Comparing these heat loads, which will come the time to deflect to much in 25 ft., is the hydrogen fuel, which must be cooled at -400°.

#### Aerodynamic Problems

Problems in aerodynamics stem from the configuration characteristics inherent in the vehicle. Forewing will have a large volume, and the leading edges must be blunt to survive the heat loads. Stability and control must be maintained at angles of attack above 0.75 deg. In addition, the aircraft must be able to survive turbulent heating rates at surface temperatures effects.

Plans have been made for flight research on both supersonic transport and hypersonic aircraft research at Flight Research Center, Bell and at the research program underway.

Supersonic transport-Northrop F-105 will investigate hypersonic problems, North American A-5A flying qualities, North American B-70 both aerodynamic heating and instrumentation systems, a prototype transport, which both, will test structural loads, and the General Dynamics/General F-111 (TFX) will determine lift-drag ratio.

NASA is preparing an agreement by which the B-70 can be used for this research, unless with NASA or USAF equips, as well as for studies of the inter-bomb concepts (AWP July 29, p. 27).

The B-70 and Lockheed J-58 will be used to determine handling qualities, and J-58 for investigation evolution and design requirements.

In conflict of the expensive

transport, the F-105 will be used to determine flying speeds, and the J-58 for demonstration techniques. The A-5A and B-70 will be used to determine air traffic control compatibility and for system evaluation.

Hypersonic aircraft. The X-15 and, if built, the hypersonic research aircraft will conduct research in the disciplines of lightweight structures, air-breathing propulsion, flight control and airworthiness.

Bell also pointed out that Flight Research Center is continuing its research for improved light and evasive aircraft, for which it uses the Jet Star, an Aero Commander and a variety of smaller aircraft. Objectives of this program are to improve stability and control, pilot display, handling qualities and to conduct operations research.

#### Critical Body

Flight Research Center also has begun preliminary work on a control flying body, actually a glider model of the M-2 flying body. The 500 lb model has been tested both by automobile and light aircraft. It was built in a few weeks at a cost of \$10,000.

Charles W. Hagan of Ames Research Center explained the growing use in aerodynamic research of simulation that ultimately will be able to fit flight control into early aircraft design. NASA currently runs three methods to assess handling qualities simulated, in which both pilot and aircraft design are represented by mathematical models, simulate stability aircraft and ground based simulation.

#### PRODUCTION BRIEFING

General Corp's A/R Research Aviation Service Div., Los Angeles International Airport, has a 32.4 million dollar contract for the conversion of 120 Air Force KC-97C aerial tankers to KC-100 tankers. Project aircraft have been converted and lots are being built for the 120. Converted aircraft will carry tanks, supplies, cargo or are combination of these. Value of the entire program is \$5 million.

As Force will sell at very nearly 1,000 converted aircraft within the next 180 days. All four will be built at Defense Supply Sub Office, Davis-Monthan AFB, Tucson, Ariz.

First sale will be for 254 aircraft including T-35, B-47, B-50, F-40, F-84 and KC-70. Second sale, also Aug. 6, is for 42 B-29 bombers located at Alameda Air Force, Calif. Third sale, tentatively scheduled for Sept. 5, is for 200 miscellaneous fighter aircraft. Fourth sale, to take place about Nov. 5, is for miscellaneous aircraft. (Continued on p. 37)



Dr. Raymond K. Kottmeyer, Director of the Bell Telephone System's Switching Laboratory, is busy components in a model of the electronic switching system.

## Amazing new telephone switching system is its own "doctor"

There are 830 transistors and 45,000 diodes in the heart of a new Bell Telephone electronic switching system.

Yet, if any components fail, finding them is easy. That's because Bell experts have given the system a need which can tell what's wrong with itself.

What's more, the system can indicate where the cure for the failure can be found in a 120-page "medical dictionary" which it authored itself.

The Bell System developed this new system for use in its first commercial Electronic Control Office.



## Bell Telephone System

which will begin operation at Succasunna, N. J., in 1965.

Bell engineers estimate that the system's speed and efficiency will locate 90% of all failures that might develop at Succasunna.

Time will mean the great reliability needed for new super-fast electronic telephone switching.

Ingenuity to the nth degree is demanded by today's communications. And, in the Bell System, the world's leading staff of imaginative specialists in military and civilian communications welcomes this challenge.



# How Goodyear "Engineered Value" solved 4 more flight problems

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**PROBLEM:** Portable refueling base  
**SOLUTION:** FLEW Tanks

**ADVANTAGES:** Lightweight. Collapsible. Store fuel for any other liquid temporarily or permanently. Can also be used for emergency life support transportation. Minimum vapor loss. More ready.



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**SOLUTION:** Goodyear S-T Nylon Tire Cord Body

**ADVANTAGES:** Maximum strength for high impact landings. Greater protection from bumps, bruising, heating, tread-cracking. Controls tire growth in service. Increases tire retreadability.



**PROBLEM:** Land a Mach 2 Fighter  
**SOLUTION:** Goodyear Wheels & Brakes

**ADVANTAGES:** Compact. More braking capacity than any other unit its size. Fast tire changes. Easy to maintain. Wheel and brake can be changed separately or together. Absorbs and holds shock.



**PROBLEM:** Develop a compact anti-skid unit  
**SOLUTION:** Goodyear Proximity Anti-Skid Detector

**ADVANTAGES:** New skid-sensing device eliminates generator and exciter, saves space. Unit, shown at right below, is 70% smaller than regular unit shown at left. Extremely efficient at high temperatures.



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## REES AND THE TEN WOLFISCHE

LEACH HERITAGE OF THE AIR—BY

Ten German Roland C.III fighters crossed the Dutch sea near Antwerp, Belgium on the morning of July 1, 1916. They were headed for another exploding raid on an Allied city. Which one? St. Omer? Calais? Dunkirk? Boulogne? No one ever found out. The German never got there.

They were first met by a very brave young pilot in No. 32 Squadron of the Royal Flying Corps. Second Lieutenant J. C. Sturgeson attacked the German formation single-handedly. But in a matter of minutes he was shot down.

Soon after that, the same formation was spotted by Major L. W. B. Rees, Commander of No. 30, on a routine patrol. Mistaking the C.III for British planes coming home from a raid, Rees flew over to join them. He didn't know they had just killed one of his own men.

Rees was piloting a De Havilland 2. Powered by a 100 hp Gnome Monosopron rotary pusher engine, the two bay bi-plane was designed around the stationary Lewis machine gun placed in the very front of the cockpit. Instead of seeing the gun

at a target, pilots aimed the airplane.

The phase Rees watched for friends was the most unusual feature ever seen up to that time. Instead of sporting the small stream of water, steam and exhaust coming from the Roland C.III leaks all the ribs.

Immense engineering made the new two-seater biplane, strange and better than its prototype. The C.III had 350-foot-long equal span biplane wings and a cross, cap-filling fuselage which gave it an over all length of 124 feet—14 ft 9 in. (tail height, 84 feet, 6 in.)—at top wing was flush with the top of the fuselage!

Photo of the Roland C.III pulled from inside out of their cockpit by only a few inches. To see downwards, they looked out of huge windows in the trailing edges of both wings joined at the fuselage. Back pilot and observer had two large side windows that were probably the first escape hatches in the history of aviation.

Powered by a Mercedes 160 hp. on glass, the Roland C.III could reach a top speed of between 100 and 110 mph and could stay in the air for three hours. Because of its great speed, it needed little fuel power. The only machine gun on the plane was a Parabellum operated weapon mounted on a revolving ring around the observer.

When an German official got his first look at a Roland C.III and its patterned mouth, he said it looked like a whale. From that moment on, it was affectionately known as "the Walfish."

Rees was almost on top of the ten Walfishes when he realized they were less than friendly. He had two easy choices to make. Get out of there. Or attack. Out of the Walfishes made his choice easier. He attacked Rees. Rees hit him with a long burst of short range and sent him diving for home.

The diving Meier aimed his D.H. 2 at oncoming Walfishes and got 30 rounds into his belly. The wounded biplane went straight down and landed in the German lines.

The rest of the formation scattered like sheep before a jumping dog. The leader of the German group and two other Walfishes kept on toward the British area. Rees followed them. He wouldn't give up the chase.

One of the observers in a Roland C.III got lucky. He wounded Rees in the thigh and shot off part of the D.H. 2's rubber.

But Rees wouldn't quit. He kept up his fire until he was within ten yards of the rear Walfish. He made one of the wounded German observer firing like a wild man on all directions. The leader of the Walfishes then gave up and turned for home. Rees kept after him

until all his ammunition was gone. Then he flew for home.

For single-handedly sporting a raid of ten German biplanes, Rees received the Victoria Cross—highest decoration in the British empire. It was a good day's bargaining.

### Did Rees stay in the RAF?

Yes. And he stayed in 1940 as the RAF Commander. This was just about the time that Leach developed his line of Balanced Armature Relays to meet the ever increasing experimental requirements of new aircraft.

### Leach is now very big in Space Electronics, isn't it?

Right again...with tape readers, information equipment, relay, timing devices. In fact, we were in the space race long before it became popular!

### What's your latest project?

Apollo. Leach has been given the contract to develop laser diode tape readers for the three-man spacecraft that will orbit the moon. The readers will weigh less than the most sophisticated modern tape readers, yet they'll have twice the capacity and require only one-third the power.



### Where are they being developed?

At Leach's home, Colorado Springs, which develops all its efforts in aerospace electronics. Leach has facilities in Los Angeles, San Francisco, New York, Washington, D. C., Dayton, Seattle, Boston, Hanford, Zurich, Geneva and Madrid. If you're thinking about space, give Leach one more year now. Why not give it a call?

Bill Anagnostou, Co., Buffalo, N. Y., has signed a licensing agreement with the Anti-Proton Hall Corp., of Laurel, Md. for the right to use, manufacture, sell and distribute, namely, employing the EPRM principle. This principle, developed by Anti-Proton Hall, no plus as, based on between plus leech to form an air pocket beneath the hull bottom and above the water surface thereby increasing performance by reducing water resistance.

Sweden Inc., Los Angeles, Calif., has broken ground for a new plant for city on its 25 acres site in the manufacturing district of Garden Grove, Calif. Total unit, about 50,000 sq. ft., will house the company's aircraft transportation facilities. When all units are completed, the 154,000 sq. ft. facility will manufacture segments of the fleet's aircraft and various plastic activities.

Lockheed-California Co., Burbank, is developing metal tape readers and methods for tape drive space systems under contract from Jet Propulsion Laboratory. Mission under study include orbiting manned space station, extended lunar base, automated relay systems and manned vehicle to return samples from Venus and a manned Mars landing and return.

Atmospheric International, a division of North American Aviation, Inc., Covington, Calif., has a \$400,000 contract from NASA's Lewis Research Center to study the interaction of liquid alkali metals such as lithium, sodium or potassium when used as vacuum lubricants of refractory metals such as tungsten, tantalum, hafnium or niobium.

General Dynamics/Convair will continue engineering studies on a General Electric T406 and Landing (IGTOL) aircraft under a \$238,000 contract from Bureau of Naval Weapons. A GIGTOL aircraft would be supported by a ground effect air cushion during vertical takeoff and landing as acceleration over an unimproved land in water surface. It would then cruise conventionally.

Bill Anagnostou, Co., Buffalo, N. Y., has received a license from the Federal Aviation Administration for the design and construction of a small aircraft. The aircraft is a two-seater, single-engine, low-wing, fixed-wing aircraft. It is designed to be a simple, easy-to-fly aircraft that can be used for a variety of purposes, including as a personal aircraft or a small business aircraft.

Bedford Instruments, Follett, Cal., has an \$59,735 contract from Marshall Space Flight Center for the development of techniques and associated instrumentation for the rapid quantitative detection of hydrogen in oxygen, nitrogen and inert gases. The instrument would be used to detect hydrogen leaked around nuclear installations.

**LEACH**  
CORPORATION

408 Washington Drive, San Marcos, Calif.  
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# Turbomeca Planning Lightplane Turbine

By Warren C. Wetmore

**Bordes, France—Gordon 3**, newest and smallest of the Turbomeca gas turbines, is scheduled to be built in prototype form next year. Turboprop version of the engine, used as 318 shp, is used in the lightplane market, while the 308-shp turboshaft version is designed for small helicopter applications.

Unit price for the Gordon 3 in a two-production is expected to be in the vicinity of \$6,000—which would place it as a competitive position with comparable reciprocating engines. Production is slated to begin in 1965.

Estimated specific fuel consumption for the turboprop Gordon 3 is 0.520 lb./shp./hr. at maximum takeoff power and 0.445 lb./shp./hr. for the turboshaft engine. Takeoff and cruise engine maximum continuous ratings are identical, while the turboprop version will develop 384 shp at an altitude of 15,000 ft. and a speed of 310 mph. Specific fuel consumption comparison of these conditions is 0.495 lb./shp./hr.

## Design Features

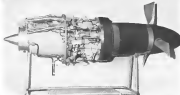
Gordon 3 is basically a scaled-down Airco 2 and employs many of the tested design features of that engine according to the company.

Compressor consists of two axial-flow stages between which six vane-stator sets of vane-type flow straighteners, followed by a single centrifugal-flow stage. Theoretical pressure ratio is 7.5 at maximum shaft speed of 65,000 rpm.

Diffuser aft of the compressor is made up of a radial and an axial section which discharges air to the diffuser flow annulus combustion chamber. Fuel is injected radially from a ring-shaped distributor located in the hollow shaft connecting the compressor and turbine shafts in standard Turbomeca technique and is used by a torch injector. Exhaust shaft rotates on four main bearings made up of ball and roller bearings. Three-bladed electric magnetically actuated on-off speed-stem is driven at a nominal 7,500 rpm by a coaxial propeller reduction gear. Output shaft speed for the turboshaft engine is 6,600 rpm.

On weight of the turboprop Gordon 3 with standard equipment is 345 lb., while the turboshaft engine at about 14 lb. lighter. Overall length of the turboshaft is 3.5 ft. and that of the turboprop is 5.5 ft., including propeller. Both versions have the same maximum diameter of about 2 ft.

Engine power is the turboprop engine is controlled by the propeller pitch control lever, which is operated in a conventional throttle-levered movement forward high pitch increases power.



**NEW GORDON 3 ENGINE**, shown in turboprop version, is Turbomeca's smallest gas turbine, with a shaft power output of 318 shp. The engine is designed for application to lightplanes and small helicopters, according to the company.

This is possible through the use of an electronic governor, which maintains a constant turbine speed by adjusting a fuel metering device downstream from the fuel pump. Turbine rotation speed is determined by the pitch lever means of a lever which adjusts the governor balancing spring.

Since the power delivered is the engine at constant turbine speed and its speed is defined by the propeller pitch, a change in fuel pitch slows the engine by increasing the rotating torque. The governor responds by automatically increasing the fuel flow—and therefore the engine power—to the pre-selected turbine speed is restored.

Propeller pitch limiter is incorporated in the system to keep the engine power within the authorized limits. This device pins into the propeller pitch lever, ensuring the maximum acceptable value for a given speed be limiting the pitch if the speed begins to decrease since maximum pitch has been achieved. Conversely, if the propeller is set at the maximum pitch corresponding to the existing speed and the speed is then increased, the limit will allow an immediate increase in the propeller pitch to produce excessive propeller drag or turbine over-speeding.

Turbomachinery that the system's self-balancing capability will be particularly useful during fuel approach. Once the propeller pitch lever is set to give the desired approach angle, any change in speed will result in an opposite power variation and hence a change in the rate of descent. The pilot is thus able to maintain the proper descent angle by adjusting the angle of attack.

Another feature of the power control system is the automatic maximum power mode, which is operated by a

pushbutton in the cockpit. Propeller is maintained automatically at maximum pitch irrespective to the actual air speed, thereby making the aircraft fly at any speed with maximum desirable power. This feature should be used until desired takeoff rate, optimum climb-out and shorted approaches. Manual override is accomplished by pulling back the pitch control lever.

Indicating gas speed is used to maintain turbine speed at a constant level in the turboshaft Gordon 3.

Time between overhauls (TBO) for both versions of the Gordon 3 has been set at 1,000 hr., a figure which Turbomeca hopes to increase after sufficient test hours have been logged.

## Other Developments

Latest model of the Airco 2 turbo shaft engine, designated the C5, is rated at 518 shp at takeoff, evolving a SFC of 0.510 lb./shp./hr. Total production of all models of the engine to date at the Bordes plant amounts to more than 1,300 units. The Aquas, of these with the later model derived in 406 shp—equal the SAE 3114 Airco 2 helicopter, while the remainder are used in industrial power applications.

Airco 2 gas section consists of a single stage centrifugal-flow compressor giving a compression ratio of 3.55:1 at 24,000 rpm. Radially-inlet diffuser guides the incoming combustion chamber, which employs a centrifugal fuel injection and torch igniter.

Two-stage axial-flow turbine with integral blisks is followed by the exhaust turbine. Shaft has two ball and roller bearings. Reduction gear at the forward end of the shaft reduces the shaft speed to 5,600 rpm.

Fully equipped for the Airco 2, the engine's dry weight is 515 lb. Overall length is 4.5 ft., height is 1.8 ft. and width is 1.4 ft.

Time between overhauls for the Airco 2 C3 is currently 1,000 hr.

Airco 3B, which powers the SAE 3114 Airco 3 helicopter, often considerably from the 3C version. Power takes a 550-shp for takeoff and maximum continuous power for a SFC of 0.71 lb./shp./hr. Engine is 6 ft. long overall, 1.05 ft. wide and 2.05 ft. high. Differences in the gas section include the following:

- Axial-flow compressor stage precedes the centrifugal compressor. Two sets of flow straighteners are installed between the two stages. Compression ratio is 5.23 at 15,500 rpm.
- Third stage is added to the axial-flow turbine.
- Shaft has four ball and roller bearings.

Dry weight of the Airco 3B with standard equipment is 327 lb., and TBO is 750 hr. Approximately 250 of these engines have been produced to date.

More than 150 Airco 2 engines have been produced in both turboprop and turboshaft versions, which develop a takeoff power of 515 and 540 shp, respectively.

Turboprop Airco 2 is employed in the Pacer 346, the SFK-346 March and the Pacer 346 Turbo-Pacer. In addition, the U-8 from of Riley Aircraft, Inc., is considering establishing a program for re-equipping the Harlingen Devers with the Airco 2 engine.

Sad Airco 2 has been extensively re-evaluated with a detailed turboshaft version of the engine, known as the Airco 2A, resulting in a reported 40% increase in the range or payload capability due to the improved specific fuel consumption. Turboshaft Airco 2 is also used in the Pacer Aquas Model 117 helicopter.

Gas section of the Airco 2A has essentially the same configuration as the Gordon 3, except that axial-flow compressor possesses only one stage and the shaft rotates on three bearings. Gas section ratio is 4.8 at maximum speed of 41,500 rpm. This rate is geared down to 6,000 rpm in the turboshaft engine used to power 2,200, 2,600 or 3,600 rpm in the turboprop version, depending on the reduction gear use.

Maximum power SFC is 0.556 for the turboprop version and 0.594 for the turboshaft version. Overall lengths are 5.36 ft. and 4.15 ft., respectively, maximum diameter is 1.5 ft. for both turboprop versions has a dry weight of 272 lb. with standard equipment, while the coaxially-equipped turboshaft version weighs about 2 lb. less.

Engine control systems in the two Airco 2 versions are identical in principle.



**TURBOMECA 3C-3**, shown in powerplant for SAE 3114 Super Pacer heavy turbine helicopter, shows 3C-3 in Super Pacer has two turbines and produces 1,000 shp each. Airco 3B turbine engine version photo, is the most powerful Turbomeca gas engine in production, generating 1,550 shp (about at takeoff). SAE 305 takes and light attack aircraft, which needs its maximum light weight, is equipped with two Airco 3B engines. Airco 3B's overall length is 6.6 ft., width is 3.15 ft. and height is 2.45 ft. Engine's power output time between overhauls is currently 750 hr.



**MARCH 6 TURBOPROP**, below, shown in test production model, is designed to be interchangeable with the March 2 and will control engine it on the Turbomeca production line. Thrust of the March 6 is 1,000 lb. at takeoff. March 6 is now flying in the McDonnell-Hughes P-2 and P-3C/Blackbird CM 310.







### Lunar landing gear . . . from the people at Bendix

Landing struts for lunar excursion craft and landing slides for manned re-entry vehicles. ☐ Other people at Bendix are working on engine control systems, landing gear, rocket equipment, high temperature composite materials and nuclear mechanisms. An Aerospace team of skilled and experienced people . . . skilled in all phases of program management, backed up by complete engineering and production facilities, give Bendix the capabilities to undertake many varied Aerospace programs. ☐ To find out what this Bendix team can do for you, write: General Sales Manager, South Bend 20, Indiana.

**Bendix Products Aerospace Division**







**TURBOMEC TD-3** 1,500-shp, turbo-prop engine shown is based on the TC3. The TD-3 will be used in the production version of the Boeing 961/941 STOL transports. In Boeing turbo-prop engine, Idaho, is composed of two Bistrot 6 coupled through common reduction gear. It develops 3,100 hp at takeoff and has been flown in Sea King Sikorsky S-60 helicopter, giving substantial performance increase.



ciple to those in their respective Douglas C-124 transports.

Turbomeca is presently developing the Astute 18, an improvement on the Astute 2 embodying a second stage in the dual flow compressor. Compression ratio is 7.5:1 or 41,000 ft.

Astute 18 will develop 660 shp at takeoff while maintaining fuel at the rate of 0.510 lb/cshp/hr. Dimensions are the same as in the Astute 2, and dry weight with standard equipment is 251 lb.

Astute 18 is under consideration as a replacement for the Astute 2 used in the F4U, 440, Turbomeca and. Further evolution of the Astute 18 is being studied. Current performance for this engine includes a 715 shp takeoff rating and an SFC of less than 0.514 lb/cshp/hr. TBO of the Astute 18 is 750 hr, compared with 560 hr for the Astute 2.

Bistrot 4 turbo-prop engine, which powers the Nord 250 Super Beechcraft light transport, has been placed as yet under a production run of approximately 100 engines.

In precursor, the Bistrot 6 is the counterpart for the Nord 352 powered Super Beechcraft Lettec and

most powerful models of the Bistrot 6, the A2 and B2—which differ only in the propeller reduction gear ratios of approximately 18.5 and 21.1, respectively—delivers a takeoff power of 1,084 shp. Corresponding SFC is 0.58 lb/cshp/hr.

Compressor for the Bistrot 6 has an axial-flow first stage and a centrifugal flow second stage with two rows of flow-straightening vanes between them. Compression ratio is 35,100 ft at 551.

Radial-flow diffuser provides the annular combustion chamber using track grates and centrifugal fuel injection. Previous has been made for the installation of a water-cooled injection system.

Three-stage radial flow turbine is followed by a sealed subsonic exhaust diffuser. Turbine blades are machined integrally with their shaft. Reduction gear output shaft speed is 1,810 rpm in the A2 and 1,510 rpm in the B2 version.

Ready-to-fly dry weight of the Bistrot 6 is 560 lb, including the three-bladed Rotax-Prop propeller. Enclosed in its nacelle, the engine measures 2.72 ft in height and 2.23 ft in width. Overall

length from the tip of the propeller hub to the exhaust plane is 3.95 ft.

Controls for the Bistrot 6 consist of two levers. One controls the turbine speed lever—which maintains the desired rpm by adjusting the propeller pitch—is set at maximum and the power lever is advanced to its takeoff stop. The latter governs fuel flow, in a function of the pressure and temperature variations at the turbine inlet.

During maximum continuous power and cruise regimes the turbine speed lever is set at maximum rpm. The power lever is positioned to obtain the desired fuel flow, which is sent from a compressor measuring the pressure differential across the compressor and calculated in fuel flow units.

Time between overhauls for the Bistrot 6 is anticipated to increase from the present 750 hr to 1,800 hr.

Bi-Turbo turbofanshaft engine consists of two Bistrot 6 engines mounted in parallel and coupled by means of a common reduction gear. Output shaft of this gear, which turns at 2,710 rpm, is geared at an angle of 30 deg. 40 min to the plane defined by the axes of the two engines.

Power of the Bi-Turbo—which theoretically could be as high as 1,800 shp—has been limited to 1,500 shp to permit flight with one of the compressors inoperative at SFC is 0.575 lb/cshp/hr.

Two engines have separate fuel system and are mechanically isolated from each other by a fire-wirehead located between the engine reduction gear and the common reduction gear. Thus, if one engine or its common reduction gear fails the other will continue to operate at its maximum continuous power.

Output shaft speed is held constant by means of an undimensional speed governor in conjunction with a double fuel metering device.

Fully equipped dry weight of the dual engine is 1,085 lb. Overall length is 6.5 ft and width is 1.48 ft.

Said Astute has assigned a Sikorsky S-60 helicopter with the Bi-Turbo, a modification which required only a 2.2-in. lengthening of the engine compartment in the nose.

Though the new engine is 75 hp lower in power than the original Wasp reciprocating engine, the helicopter's maximum speed has been increased 7 mph to 110 and the service ceiling need to 11,900 ft, a gain of 2,000 ft. Major gains were realized in hovering capability. Hovering ceiling in ground effect rose increased to 11,350 ft in comparison to 4,900 ft and hovering ceiling out of ground effect rose to 2,900 ft to the new figure of 4,900 ft. Stall speed was increased from 102 kt to 248 kt.

Another addition to the Bistrot

family, the turboshaft Bistrot 7 is now being developed. Designed to develop 1,300 shp at takeoff, the engine is slated to power the first S-130 assault helicopter (AW 101) by 29-40.

Most powerful of Turbomeca's turbo shaft and turbo-prop engines is the five turbine Turmo 500, of which two models are under development.

• Turmo 503 turboshaft engine is designed to power the Sea King S-61 Super Feline helicopter. Takeoff power using 1,400 shp for a SFC of 0.595 lb/cshp/hr.

• Turmo 504 turboshaft engine is derived from the TC3 and has the same power and fuel consumption figures. Production models of the Bistrot 641 and 942 four engine STOL transports will be equipped with this engine.

Production of the two engines began in 1965 for the Super Feline and Bistrot 641-942. Turbomacs now looks that for Bistrot 641-942, the order for its seventh—last—batch of the engines—will be smaller than original anticipated.

Gas turbines are selected for both engines and compress a two-stage axial-flow centrifugal flow compressor, followed by a 5.5:1 compression ratio, and middle combustion chamber with centrifugal fuel injection and a two-stage axial flow turbine with integral blading. Turbine speed at takeoff is 15,150 rpm.

Engine runs at a two-stage free turbine at a second speed of 19,000 rpm, which is geared down to a 1,700 rpm output shaft speed in the TC3.

For a description of the TD-3 (and its predecessor TC3) see the Wasp and Super Turboprop, July 15 p. 75.

Dry weight of the Turmo 503 with standard equipment is 484 lb. Overall length is 6.5 ft, width is 2.33 ft and height is 2.26 ft.

Dimensions of the Turmo 504 include an overall length less propeller (shaft and propeller) of 6.71 ft, a width of 1.6 ft and a height of 1.95 ft. Dry weight including fuel pipes is 604 lb.

TBO for the TC-3 is 1,000 hr, compared with 750 hr for the newer TD-3. Turbomac's entry in the small turbo-prop engine area is the Bistrot 100, which, with a takeoff thrust of 1,550 lb, is the company's most powerful jet engine now in production. Maximum thrust SFC is 0.660 lb/cshp/hr. thrust/hr.

Two Aérospatiale power the Sea King S-61 and the first attack aircraft, which work as civilian light aircraft. Engine has prompted considerable interest within the aviation industry, one company official said. Quores have also been received concerning the feasibility of conversion of present aircraft to the Aérospatiale. Aérospatiale has a device on which and several variable camshaft guide vane. Single-stage axial flow fan

which is also the last compressor stage—driven at a lower speed than the turbine shaft by means of a central shaft drive.

Two flow straightener guide provide the separate cross which divides the air from the fan into the hot and cold flows. The latter passes through a second stage gas duct, surrounding the hot turbine. Second stage axial flow compressor is located at the rear of the low-flow section preceding two rows of vanes.

Third compressor stage is a centrifugal-flow, 9:1, and is followed by the radial-flow diffuser. Compression ratio across the three stages is 6.9:1 at 32,100 rpm.

and is mounted centrifugally into the radial-flow diffuser and is equipped in means of two bolted vanes (supported by a double gasket).

Aérospatiale turbine consists of two axial flow stages with attached blades. Exhaust diffuser also acts as the tail pipe for the hot gases. Cold flow turbine is separate at the exhaust plane the two flows are mixed.

Standard equipment for the Aérospatiale includes magnet, fuel pumps for fuel and oil, and oil, and starting system. Dry weight of the engine thus equipped is 510 lb. Overall length is 6.6 ft, width is 2.12 ft and height is 2.47 ft.

Present model TBO for the Aérospatiale has been set at 750 hr.

Present model after using the Turbomac engine is the Bistrot 2 turbo jet which is rated at 800-hp. thrust. More than 1,500 units have been produced in the United States by Wasp and Super Turboprop, July 15 p. 75.

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U.S. is Commercial and built the designation 308. Cessna T-37 trainer and the Ryan Firefly light transport are equipped with the 308.

Marathon 2 has a SFC of 1.15 lb/cshp/hr at maximum thrust. Engine's gas section employs a single stage centrifugal flow compressor giving a compression ratio of 6.2 at 22,600 rpm.

At the rear of the engine is the radial subsonic diffuser, annular combustion chamber with centrifugal fuel injection and a centrifugal axial flow turbine, with integral blades. Exhaust diffuser has curve and a large for mounting the tail pipe.

Dry weight of the Marathon 2 with standard equipment is 150 lb. Engine is 3.15 ft long overall and 1.87 ft in diameter. TBO is presently set at 750 hr.

Marathon 2 is scheduled to be placed out of production in favor of the more powerful Marathon 6, although Turbo-macs has that a substantial backlog of Marathon 2 orders still exists.

Marathon 6 generates 1,600 hp thrust at takeoff for a SFC of 1.11 lb/cshp/hr. Weight and dimensions are identical to those of the Marathon 2—the engine set against to be substantially the same, except that detachable blades are used in the turbine.

Marathon-Nordair Part 1 and the Turbo-Harvard CM-101 are both powered by the Marathon 6, it will be later. Fugate Magister Company said that there is a possibility that the Magister now in service will be retrofitted with the engine. About 100 Marathons have been built.

Turbomacs' present monthly production rate is 70 to 80 engines. Breakdown of the figure, not very considerably, but on the average Marathon 2 and Bistrot 100 are produced at approximately 95, with the latter being divided among the remaining engines.



## CH-119 Undergoes Sea Tests

Boeing Vertol CH-119 helicopters produced for the Royal Canadian Air Force is shown being lifted by Cape May, N.J., during recent water landing and stability evaluation tests. Tests were conducted in Sea State Three conditions in 3 to 4 ft. waves. Tests included a 900 deg. turn, towing into and out of the water pattern and floating parallel to the wave pattern. CH-119 has been selected by RCAP for search and rescue operations.





Curtiss-Wright X-19 VTOL is beginning ground engine runs and taxi tests prior to the first flight scheduled for October. The research vehicle was rolled out recently (AW July 26, p. 21) at the company's Caldwell, N. J. facility.

## Curtiss-Wright X-19 VTOL Research Vehicle



X-19 is powered by two Lycoming T55 turbo-shaft engines mounted side-by-side in the upper rear fuselage. If engines are cross-ground to all four tilting propellers, propellers and the X-19 is designed to be capable of achieving maximum performance on one engine. The cockpit of the X-19 has two-place, side-by-side seating with conventional airplane controls in the left seat and belt-escape controls in the right seat. "Caldwell" control sticks in a throttle to control engine thrust output. Pitch, roll and yaw are controlled by differential thrust from the four propellers.



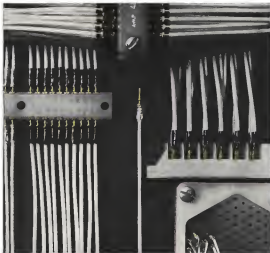
Short-span wings, located low and aft of the X-19's center of gravity, provide lift during high-speed flight. Lift in hover is provided by propeller thrust alone and during transition lift is provided by a combination of wing, propeller and radial propeller thrust.

## Begins Ground Tests Prior to First Flight in Fall

Engines are linked mechanically to the propellers lift pods, and there is no independent flap control. Main wing flaps are full-span, with slats inboard. Speed range will vary from hover to 400 ft. (100 mph) (AW Aug. 6, 1962, p. 64). Flight tests are scheduled to move to Edwards AFB, Calif., in August, 1964, and to encompass a year later.







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# SPACE TECHNOLOGY

## Syncom 2 Succeeds in Early Experiments

By George Alexander

**Cape Canaveral**—Syncom 2 was slowly drifting into position over Brazil late last week as the National Aeronautics and Space Administration planned to take it into orbit within the next 10-14 days and then make it the first satellite to achieve synchronous orbit around the earth.

Syncom 2, developed for NASA's Goddard Space Flight Center by Hughes Aircraft Co. (AVC Dec. 32, 1960, p. 32), appeared to be a major success for the U.S. space program. It retained "excellent quality" voice, teletype, image, facsimile and test time transmissions between a ship stationed on the west coast of Africa and land stations at Lakehurst and Ft. Dev, N.J. These stations are operated for NASA by the U.S. Army Satellite Communications (SATCOM) agency.

### First Experiment

First communications experiment with Syncom 2 was successfully attempted July 26, the day of its launch, as the satellite flew upward on its long trajectory ellipse to a circular and synchronous orbit. Subsequent experiments, which included two-way telephone conversations and a test recording of the Star Spangled Banner, were conducted immediately after achievement of a circular orbit (about 6 hr. after launch) and at approximately 12-hr. intervals thereafter.

The only month discussed by early last week, was a technological operating temperature of 437° within the spacecraft. NASA and Hughes engineers had expected a range of 33-51°F. Since the technology permits in use of the satellite's two altitudes and relative orbital system is less efficient at the lower temperature, the civilian space agency was considering changing Syncom's orientation to bring it twice directly into the sunlight and then once in total darkness. The reorientation, besides being the possible, also would provide a better charge on the solar cells around the spherical walls of the spacecraft.

The anti-rotation communication satellite was launched from here at 9:38 a.m. (EST) July 26 after three postponements earlier in the week (AVC July 29, p. 27). The Space Data System vehicle, built by Douglas Aircraft Co., successfully orbited its payload in 30 attempts, it missed its planned orbit once by only 0.5 sec.

The first stage, a modified USAF Thor IRBM developed about 178,000 lb thrust and burned for 144 sec. The second stage, powered by an Aerojet-General liquid-propellant engine of 7,500 lb thrust, separated and ignited about 4 sec later, burning for about 164 sec to about T + 316 sec. The third stage, the Syncom 2 payload was jettisoned at T + 380 sec, at about 30 sec. out of second-stage operation.

A 60-sec coast period followed here out of the second stage, during which time the Bell Telephone Laboratories radio-command guidance system made steering corrections. The Delta is guided by a Thor autopilot during first-stage burning.

At T + 355 sec, small stabilizing gyro wheels were fired to impart a spin of 150 rpm to the third stage and the payload. Two months later, the so-called second stage was dropped. The third stage, an Alouette Ballistic Laboratory solid-propellant motor, was fired at T + 572 sec, and burned for 46 sec, impacting Syncom 2 into a highly elliptical orbit with a perigee of about 148 mi.

The flight plan called for Syncom 2 to fly approximately half of this elliptical monthly orbit, transferring to a circular orbit at the apogee point. During Syncom 2's climb out to apogee (5 hr. 33 min. lag in the flight), the third stage was jettisoned at 9:42 a.m. (EST), and the mating maneuver started on at 10:01 a.m. The tripropellant stages were fed into Goddard's computers at the center's Greenbelt, Md., facility, and computations were made as the optimum attitude for firing of the apogee "kick" motor, contained within the center of the spacecraft.

### Apogee Motor

The Jet Propulsion Laboratory-developed solid-propellant apogee motor, developing nearly 1,000 lb thrust, was fired at 5:36 p.m. by a preset timer nearly 6 hr. after launch. It placed Syncom 2 in a slightly eccentric elliptical orbit. The perigee at 24,200 mi. was slightly lower than the planned 21,500 mi. Injection velocity was about 80 ft/sec higher than ideal figure of 10,687 ft/sec.

The apogee, at 21,740 mi., also was lower than the planned 22,950 mi., and



### Rendezvous Radar Used in Simulator Study

Prototype space rendezvous radar developed by Raytheon Space and Information Systems Division at the Martin Co. under contract and docking standards. Full-scale space flight simulator is being used to test and evaluate the phase-matched, sub-orbit CW radar planned for use in advanced spacecraft systems.





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### Simulators Aid Launch Problem Study

Extensive study and testing of typical launch problems is carried out on test simulators at The Naval Airborne Command and Control Equipment Development Center, Naval Air Station, Fort Belvoir, Ill. The simulators at left has "house" type launch similar to those found at Vandenberg Air Force Base and Cape Canaveral. Vehicle has vertical rise of 12 ft at launch velocities and boost has a vertical velocity of about 5 ft. Nine test configurations (black) is probably a more realistic scenario type launched by an Atlas/Agena. Background simulators test deployment configurations at Vandenberg AFB with vehicle vertical rise of 12 ft, and dog situation at 30 deg. The Agena configuration probably would be loaded by a Thor.

the period, at 75 to 18 min., was less than 25 min. then planned. All test parameters, however, were well within the simulator's corrective capability, NASA said.

Although true orbital exercise was not a required option, three total orbital exercises and the consequent differences in relative velocities between the satellite and the rotating earth caused Saturn 2 to lead the earth by

about 7.5 deg. per day in an eastward direction.

In order to take up a position over 55 deg. west longitude (approximately over Brazil), roughly 100 deg. from its circular orbital position past over the North Pole, Saturn 2 was to have drifted westward at a rate of 57.5 deg. daily.

The USS Koppert, in the Lagoon



### PROFESSIONAL OPPORTUNITIES

Aerospace/Naval Airborne Command and Control Equipment Development Center has highly qualified professional engineers who will provide project engineering and technical assistance for the total development of systems of MCMC. Responsibilities include engineering and development of design, development, planning, and test activities. Candidates will have broad solid rocket engine and development experience, in addition to management experience in one or more of the following:

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nitrogen gas jets will be activated to tip the vehicle 90 deg. so that Seasons 2's open nose will be perpendicular with its orbital plane. With this orientation, the satellite's transmitting omnidirectional antennas—which fan in the plane of the open nose—will always point toward earth.

Satellite-to-ground transmissions will be on frequencies of 1,204.1,516 mc and from ground-to-satellite at 7,105.7,360 mc. The tracking beacon operates at 1,830 mc. Gain of the omni-directional earth receiver is 5.5 db, and the satellite beam is pencil-beamed. Beam cover roughly 100 deg. of the earth.

The 26 in. dia., 15.5 in. tall dome-shaped satellite was lightly modified from its earlier version launched from here last Feb. 14 (AVR Feb. 12, p. 34). Modifications (AVR June 10, p. 115) included: removing of the electrical harness to provide additional paths for critical command and power circuits; addition of a small identical emergency battery for the telemetry transmitter and a backup battery; addition of an accelerometer to measure gloads during firing of the apogee motor; substitution of the 800 Hz. apogee motor for the 100 Hz. motor used on the first Seasons, and reduction of pressure in the sphere of gaseous nitrogen used for attitude control.

Tests conducted by Hughes after the failure of the first Seasons led the company to believe that the spherical balloons that contained nitrogen under 1,600 psi developed under the acceleration of the 900 lb thrust apogee motor. Pressure, therefore, in the Seasons 2 nitrogen sphere was reduced from 3,000 psi to 2,500 psi.

The net result, according to Alton E. Jones, Seasons project manager for Goddard, has been effective in increasing the gap of the sphere's skin thickness and thus made it less vulnerable to acceleration loads.

These changes added about 4 lb. to Seasons 2's weight compared with Seasons 1. However, substitution of the JPL motor for the Telextron engine provided a 70 lb. weight saving over the latter. Including the weight of the apogee motor's propellant, Seasons 2 weighed 1,477 lb. Seasons 1 weighed 1,600 lb. After firing of the motor, Seasons 2 and its non-apogee motor can weigh 90 lb. Seasons 1 weighed 56 lb.

Like its predecessor Seasons 2's cylindrical nose was covered with 1,640 micron solar cells, which provided electrical power in the vehicle's own radioisotope batteries.

Seasons's circuitry includes a clocked area for transmitting, a duplexer for receiving and four timers clocked around the middle of the apogee motor, for telemetry and command.



## IGNITION SUB-SYSTEMS GO! or NO GO?



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## Liquid Hydrogen Test Facility Bids Requested

Montreal, Ala.—National Aeronautics and Space Administration has requested bids on the construction of a liquid hydrogen test facility at the Marshall Space Flight Center here.

The proposed facility, which will include test stand and support equipment, will be used for static testing the Blackstone F-1 rocket engine and a new flight version of the Saturn 5-08 stage, employing one F-1 engine. Proposal has been set aside for award to a small business, according to the Mobile District, Army Corps of Engineers, construction agent for the job.

Single-point test stand will consist of a bonded steel superstructure 11 x 66 ft., with the highest portion about 146 ft. high. Support will be a rigid concrete mat resting on steel piles.

Stand will have a direct deflector with a water deluge system, a sliding steel deck, with two roll-up doors, and two lifting devices, each 50 ton and one 75 ton.

New facility will be opened in comparison with blackstone facilities being constructed under a \$19,754 contract awarded by the Marshall center last October.



### Long Solar Cell

Expanded photo solar cell (left) 18 times the size of conventional 3 x 2 cm cell (right), a long produced by Westinghouse Electric, and company developed double-point power. Cell is based by growing two small diode crystals used normally. As the crystals are cut from between the two work layers the surface of solar cell. Company has delivered panels of 12 in. long solar cells to USAP's Aeronautical Systems Div. for testing.



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### S-66 to Measure Electron Density Profile

Ionosphere beacon satellite designated S-86 by National Aeronautics and Space Administration will be launched into a circular equatorial orbit from Ft. Aguilar, Calif., aboard a Scout launch vehicle no sooner than Aug. 19.

The satellite's orbit will be inclined 40 deg with the equator at an altitude of about 600 km., with a period of approximately 107 min., permitting the S-65 to sweep each area of the earth's hemisphere every 24 hr.

## Adapted from Transit

The S-65 was designed and built for NASA by the Applied Physics Laboratory of Johns Hopkins University. It is adapted from the Navo's geostationary satellite, Transit, also engineered by the Applied Physics Laboratory of Johns Hopkins.

Objectives of the experiment are to measure the total number of electrons between the satellite and earth as a function of latitude, season and diurnal time. Vertical profiles of electron density and small-scale irregularities in the ionosphere and their geometry will also be obtained. Other objectives will be to study bulk behavior of the ionosphere as it varies in space and time.

with increasing solar ultraviolet and X-ray radiation.

In addition, personnel at Wallops



**UNDERGOING SPIN TEST** at Pacific Missile Range atmospheric-burns satellite will measure electron density variations from pole to pole.

Stinson, 1, will try to illuminate 360 one-to-one faced when prisms attached to the octagonal shaped satellite by reflecting a laser beam mounted on a tracking telescope off the array of prisms. The reflected laser beam will return to the telescope to be amplified by a photo multiplier tube. A digital counter will record the total time the light took to reach the satellite and return to the ground. Precise position of the satellite can be obtained from this information by a combination of clipped laser line of laser beams and smooth television audio.

This will be the first time a laser experiment has been conducted with a satellite, but NASA scientists say chances of success are marginal for the moment.

## Ruby Lounge

Goddard Space Flight Center will use a 4-in. synthetic tube and liner system fabricated by General Electric's Wende and Space Div., Valley Forge, Pa. The tube and liner are highly energized by electric it recovers from a severe goddard fish trap mounted closely parallel to it is a special basketlike metal housing.

Both ends of the inked rod are polished and set like cactus. The green light from the flash lamp creates clear marks along within the rod which recede and light. A fraction of a millibeam of a second later, the laser beam passes through the end of the rod which has been made more transparent than the other.

The 3-66 weighs about 110 lb. Its shell is made of brass-colored nylon and glass fiber. It is 55 in. in diameter by 52 in. high. Satellite spin is decreased from 40 to 4 rpm by changing the spin arm moment of inertia. This is done by means of four Madsen hold-in plates by despin assembly cables that are timed to release 7 min. after motor burnout and separation of the satellite into orbit.

### Electron Probe

The atmospheric beacon satellite is equipped with an electron probe extending from top to bottom of the shell.

Two 5-ft. whip antennas and two dipole antennas for the transmitter extend from the ends of opposite blades and another whip antenna for the 550 command receiver projects from the bottom of the satellite.

Electron density measurements will be made using the Doppler shift and Faraday rotation methods. The Doppler shift is signal frequency sent out by the satellite varies with the satellite's velocity and electron density, through which the signal passes.

As the ionospheric beacon satellite moves toward the ground station, the signal frequencies it sends out are slightly higher than the transmitted signal frequencies.

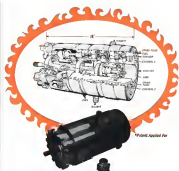
The opposite effect occurs as the satellite moves away from the ground station.

**D.** comparing. Droplet shifts at several frequencies, it will be possible to determine total electron content and density.

### Forcedy Revision

The Fourier rotation technique depends upon increasing the number of turns the polystyrene films of radio waves from the 8.06 are rotated as they pass from the sample to earth. The number of rotations are measured at several frequencies from which electron densities are calculated.

A worldwide group of 40 U.S. and foreign scientists have volunteered to read out data sent by the satellite's side beacon, making possible a global survey of the earth's ionosphere. A global survey of this kind would result in information necessary to predict communication blackouts from storms, solar flares and solar frequency variations caused by changes in the ionospheric layer.



**Abstract**

**PROBLEM:** To pump and proportion a fuel, an oxidizer, and a corrosive diluent in a single unit.

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which delivers precise proportions of these such liquids, accommodates widely varying inlet pressures and produces discharge pressures of over 3,000 psi. Capable of operation at shaft speeds from 1250 to 7500 rpm, overall efficiency at rated flow and pressure is demonstrated to be over 75%. Combined maximum capacity of the three fluids is over 40 gpm per motor. It also incorporates a small flow displacement pilot pump which can deliver another fluid at a nominal flow output of 2 gpm per motor.

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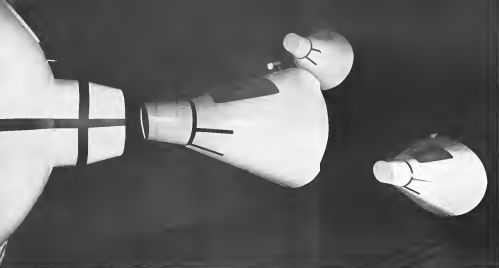
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Triple exposure photograph in new Martin Rendezvous Laboratory shows spacecraft making approach

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## **1 SYSTEMS ANALYSIS**

Specify guidance equations and targeting programs. Investigate dynamics performance of guidance steering loops. Develop digital computer error analysis program.

## **2 GUIDANCE SYSTEM ENGINEERING**

Project management including servo loop analysis and design specifications for sub-systems such as stable platforms, airborne digital computer, star tracker, and gyro performance requirements. Task will be in both terrestrial and celestial modes in connection with land and sea deployment.

## **3 FLIGHT CONTROL SYSTEMS ENGINEERING**

Adaptive and optimal flight control systems analysis and design for a mobile missile. Office are concerned with aerodynamics stability, surface loading, re-entry energy management, control systems simulations and servo feedback control techniques.

## **4 SYSTEMS DEFINITION AND INTEGRATION**

Study and define performance requirements of variety of guidance and control sub-systems and establish criteria upon which interface specifications are prepared. Particular emphasis is given to systems analysis of special purpose airborne digital computer and programming.

## **5 DIGITAL COMPUTER PROGRAMMING**

Develop real time airborne digital computer special purpose programs. Heavy requirements for those experienced in numerical analysis, self test routines, diagnostic programs, acceptance test programs and time storage estimates.

## **6 ADVANCED PROGRAMS—PROGRAM MANAGERS AND SENIOR STAFF ENGINEERS**

A newly formed branch of our Aerospace Systems Division is being staffed at senior levels and requires talented technical and managerial candidates who will be concerned with our product line of the future. Areas now requiring additional key engineers are: advanced systems R & D—astrothermodynamics—electronics and communications—astrodynamics—structures & materials—astro/aerospace physics—applied math & computing—reliability—human factors—advanced systems requirements and developments, guidance, computer, control & radiation systems engineering, system integration—mechanical systems.

## **7 SCIENTIFIC PROGRAMMING COMPUTATION**

Translation of scientific mathematical expressions into FORTRAN and FAP languages for computer solution in IBM 7000 series or RPC 4000 machines. Scientific programs involve guidance equations, physical parameters, terrestrial deployment and trajectory simulations, adaptive flight control systems and hybrid guidance systems.

## **8 FIELD FLIGHT TEST**

Conduct on-orbit flight testing of prototype stellar/inertial guidance systems. Requires field experience with knowledge of inertial guidance equipment. (Location is Cape Canaveral, Fla., with initial training in Little Falls, N.J.)

## **9 TELEMETRY—INSTRUMENTATION**

Plan and design airborne missile PCM telemetry and data reduction instrumentation systems for flight test programs.

## **10 CONTROL THEORY MATHEMATICS**

Senior Staff Scientist will be responsible for advanced research programs in modern control theory. Work will involve utilization of calculus of variations, dynamic programming, Lyapunov's Second Method, and requires a background in ordinary differential equations.

## **11 FLIGHT TEST ANALYSIS**

Create and design flight and sled test programs for ballistic missiles and analyze system performance data.

## **12 ELECTRO-OPTICAL SYSTEMS**

Design and analysis of electro-optical instruments for integration in stellar/inertial guidance systems. Requires knowledge of astro-sensor in digital data handling and signal processing devices.

## **13 ANALYTICAL MECHANICAL DESIGN ENGINEERING**

Conceptual design of guidance and control space environments simulator systems. Analytical and design capabilities should be in vibrations, acoustics, thermodynamics, vacuum analysis and electronic control instrumentation.

## **14 RADIATION STUDIES**

Principal staff scientist's research will explore plasmas, wave propagation, energy conversion, and infrared technology. By studying areas such as field geometries, attenuation problems in diffusing fluids, thermo-electric effect, ferro-electric and thin films sensors, lasers and masers, and applications of new semiconductors, unique space technology applications will be developed.

## **15 INERTIAL SYSTEMS ELECTRONICS**

Analysis and design of sophisticated electronics devices for inertial systems implementation. Requires background in one or more of the following: Guidance and control systems, analog computer electronics, network theory, information theory, solid state and micro miniature circuit design and electronic packaging.

## **16 ANALOG-DIGITAL CONVERSION & COMPUTATION**

Analysis and design of all electronic solid-state A/D and D/A converters; digital integrators, and hybrid computing equipment. Strong advanced circuit background necessary with knowledge in system analysis, digital logic, precision pulse generation and switching, multiplexers, digital and analog storage techniques, high speed sampling & sampled data theory.

## **17 ASTROPHYSICS**

Responsibilities will include the coordination of reference systems integration with digital computer programs of various integration schemes in orbital and trajectory work, utilization of star catalogues and determination of stellar groupings and position. Experience in orbit and trajectory analysis is necessary.

## **18 GROUND SUPPORT EQUIPMENT**

Direct technical development of electronic ground equipment to support advanced aerospace systems. Working knowledge in digital automatic check-out systems, automated data handling and/or test evaluation of guidance and control systems and components.

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## 19 DIGITAL SYSTEMS ENGINEERING

System application and utilization of real time airborne digital computers for stellar inertial guidance systems. Major technical task responsibilities in preliminary digital computer logic and circuit design. Evaluation of computer development and vendor technical techniques.

## 20 ELECTRONIC COMMUNICATIONS

Transistorized analog circuit design, communication, telemetry, instrumentation and/or oceanography, and radio effects on electronic circuits.

## 21 DATA HANDLING SYSTEMS—INPUT-OUTPUT EQUIPMENT

Airborne Packaging—Environmental aspects, heat transfer and vibration problems.  
Data Memory—Memory circuits, magnetic drums, delay lines and readout circuits.  
Logic Design—C & D of digital systems equipment.

## 22 RADIATION SYSTEMS ENGINEERING

Theoretical studies and analysis to apply passive radiation sensors and lenses to tactical airborne guidance systems.

## 23 DISPLAYS & CONTROLS ENGINEERING

C & D of airborne and ground based visual displays and instrumentation for aircraft and space vehicles. Experience should be in CRT displays and electronic design of simulators or trainers.

## 24 GUIDANCE AND SYSTEMS ANALYSIS

Evaluate proposed Inertial R & D programs with respect to technical feasibility and allocation of funds. This position also entails high level customer contact. Advanced degree required with experience in the fields of modern guidance systems.

## 25 GUIDANCE & NAVIGATION

Principal staff scientist will direct research programs in terrestrial and celestial guidance and navigation. Investigations will utilize the theory of gyroscopes as applied to inertial navigation systems for problem areas such as celestial navigation for periods of time longer than the Schuler period and the use of star tracking information for correction.

## 26 MICRO-ELECTRONICS

Advanced semiconductor device development, involving some of the following areas: thin film, epitaxial growth, high vacuum techniques, photoetching and hardware testing, diffusion processes as applicable for planar transistors and micro-circuits.

## 27 ELECTRONICS INSTRUMENTATION

Direct and conduct theoretical studies aimed at the creation of new devices and instrumentation. Area of development will include end-product and VME communications, antennas, oceanography, sonar, telemetry, and data measurements instrumentation (sensors & transducers).



**MILES M-100 STUDENT**, ready for takeoff at Le Bourget Airport during the Paris Air Show, is two place, side-by-side trainer which can be stretched to a four-place communications airplane by adding seat in equipment section.

### *Aviation Week Pilot Report*

## Politics Cloud Future of Miles Student

By Herbert J. Coleman

London—Miles M100 Student jet trainer, an uncomplicated and forgiving airplane, has several potential uses ranging from initial training to ground school, but its future is still clouded by politics in Great Britain and South Africa.

The crux of the matter is a dispute between the members British Labor Party and the South African government over the latter's adoption of apartheid white supremacy policies. In a number of bitter attacks, spearheaded by Labor Party leader Harold Wilson, the party has demanded cessation of all sales of arms to South Africa for fear they will be used against the black races.

South Africa has, however, purchased 20 Blackburn Buccaneers naval strike fighters, under a 1955 agreement between Britain and South Africa for joint defense of sea approaches. The Laborites insist that the contract be canceled, but that is doubtful even if the party regains control from the Conservative in the next general election.

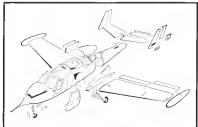
To exacerbate the political squabbling—which already has probably cost blurring aircraft in order for the jet trainer—British F. G. Miles Ltd., builders of the Student on "de-Apartheid" the airplane is stuck in posi-

tion, and are negotiating for a license to produce it in South Africa.

Chairman of the firm and designer of the Student, Forebank, G. Miles, and the first name in the document will be to refit the airplane with the Turbo-propeller turboprop engine, using powerplants built in France, despite the fact that British Siddeley Engines, Ltd., has a production license agreement with the French company.

The trainer's armaments and components parts also will be French although these are optional to South African devices. The landing gear probably will be built in a South African firm.

If the deal is consummated, South Africa will set up its own production facilities, under the guidance of F. G. Miles Ltd., which will staff the facilities for in-house training and gradually



**MILES STUDENT** is broken down for production into above sub-assemblies.

## A FORMAL RESUME IS NOT REQUIRED

Just describe present job responsibilities, type of degree held and openings in which you are interested. Also, home address and phone number. We will contact you promptly. Please address inquiries to Robert LoPresto, Dept. 100.



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**POWERPLANT FOR AIRS STUDENT** is a Turbomeca Machco 2A turboprop engine of 580 hp thrust. Follow-on M510 Graduate will be powered by a Turbomeca Astutec turboshaft of 1,350 hp thrust; no major changes in software are needed.

a spin. Altitude loss is a clean spin at this rate is about 1,000 ft.

During the stall, flight weather had deteriorated to a 400 ft ceiling. For the landing approach, the downwind leg was relaxed at 140 mph and was flown at about 150 ft with no crosswind. The landing gear was lowered at 140 mph, followed by 35 deg of flap. The final approach was flown at 140 mph, at this rate at a 400 ft ceiling, about 15,000 ft.

The threshold was crossed at 85 to 90 mph, and because of the 7 to 12 sec lag in throttle response for a go-around, the throttle was not closed to idle until the point was one of a safe landing in the first third of the runway.

The low height of the Student (6 ft 3 in.) provides good ground handling characteristics. That turn is possible with little chance of tipping or dragging a wingtip. The engine can be used quite easily on rough surfaces and gusty winds, since the intake location above the cabin prevents ingestion of foreign objects into the engine.

For its ground support and attack role, the Student can be fitted with two Gerbacs gear carrying 11 5-lb rockets which can be fired two at a time from each side as in a ramjet or as 42-inch rockets. Other armament alternatives include eight 15-lb bombs, six rockets with 25-lb warheads and two 30-lb cal machine guns with 350 rounds each.

M510 and the space behind the two pilot seats, normally used for equipment storage, can be designed to take an other two-passenger seat. This version would be for use in concentrations or personnel transport roles. The cabin is 45 in wide with 35 in of headroom. The space behind the seats is 23 in deep.

The Student is built around a central keel which extends from the nose wheel attachment point to a point just aft of the main landing gear. The cabin floor acts as a dual in case of a wheeling landing. All parts of the airframe which could affect pilot safety, in an accident are stressed to 2g.

Automobile type doors on each side of the fuselage measure 46 in x 44 in and give direct access to the seats. Value of this feature, combined with high internal capacity or intake, is in cooling, heating, pressurization without venting down the engine.

Fuel is stored in two tanks in the wing and is controlled by three fuel valves, two directing fuel from past and aheadboard tanks and the third controlling the supply between the boost pump and the engine. In case of an in-flight fire, fuel is vented out by a fuel tank located forward of the left and right seats and it will operate all four valves.

## FINANCIAL BRIEFS

Boeing Aircraft Co. earned \$6.8 million-\$1.64 per share on sales of \$774.1 million during the first six months of the fiscal year ended May 31. Comparable figures for last year showed earnings of \$4.3 million-\$1.04 per share on sales of \$719 million. Order backlog stood at \$786.2 million compared with \$874.6 million on May 31, 1962.

McDonnell Aircraft Corp. earned \$37 million—equal to \$4.71 per share—on sales of \$767.4 million for the fiscal year ended June 30. Figures for last year showed \$33.9 million—\$3.80 per

share—on sales of \$708.7 million. Order backlog totaled \$938.9 million on June 30 compared with \$716.8 million the previous year.

North American Aviation, Inc., reports a net income of \$27.9 million on sales of \$1.1 billion—\$3.35 a share—for the nine-month period ended June 30. Sales growth last year showed \$24.9 million earned on sales of \$1.2 billion—\$2.94 per share. June 30 order backlog stood at \$1 billion compared with \$1.1 billion the year before.

Annapolis Corp. had sales of \$45.8



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Lisle Chip Detectors are also widely used in jet and reciprocating engines, accessory drives, etc.

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million with savings of \$1.9 million — \$1.83 a share — for the first nine months of its fiscal year ended June 30. Comparable period last year showed sales of \$48.6 million with savings of \$2.6 million—\$1.94 per share.

Westinghouse Electric Corp. earned \$25.6 million, equal to 72 cents a share, on sales of \$1.1 billion during the first six months of 1963. First half of 1962 showed earnings of \$25.5 million, equal to 80 cents a share, on sales of just over \$856.9 million.

B. F. Goodrich Co. had sales totaling \$412 million with earnings of \$14 million for the first six months of 1963. Figures for the first half of 1962 showed sales of \$406 million with earnings of \$14 million. For these months for both years were \$1.51.

Hawker Suddley Group reports a record \$56 million in 1962 compared with \$51.2 million earned in 1961. The group says it has written off about \$28 million in R&D costs for the de Havilland Trident III-125, Avro 748 and Whetstone Cluster-650 transports. From now on the company reports that all Hawker Suddley aircraft will have Hawker Suddley numbered designations.

Thompson Ramo Wooldridge, Inc., reports sales of \$248.1 million with profits of \$7 million equal to \$1.54 a share for the first six months of 1963. Same period last year showed TRW with sales of \$234.6 million with profits of \$6.4 million or \$1.68 a share.

High Voltage Engineering Corp., earned \$753,000, 12 cents per share, on sales of \$9.6 million for the first half of 1963. Comparable figures for last year showed \$594,000 earned, 21 cents per share, on sales of \$7.5 million.

Viste Corp. of America, had net income of \$458,446—56 cents per share—on sales of \$25.2 million for the first half of 1963. For the same period last year Viste had profits of \$471,032, 58 cents per share on sales of \$24 million.

United ElectroDynamics, Inc., has maintained a major concentration of its corporate and divisional efforts to strengthen its operations after a net loss of \$294,451 for calendar 1962. The reorganization and cost reduction program will combine the United Aero Space Div. and the United Testing Laboratories Div. into a new Aerospace Div. Under the direction of D. D. Malley, vice president and manager, A. Manufacturing Div. and a Managing Director also been created.

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The Structural Loads Analysis Group conducts studies leading to definition of the complex Spectrocraft heat spectrum analyzing performance, lift-off, boost, landing (and air water), and recovery. Calculations will be made for the complete life cycle—pre-flight combination, including stress effects, control system operation, and atmospheric conditions to ensure the all-weather level operating throughout the mission.

### CUTTING

The Structural Loads Group will determine initial structural design criteria from Spectrocraft heat flux and MAHA. The Criteria Group will complete ground coefficient comparisons and space flight, shock, re-entry, and water landing, and recovery experience.

### METHODS

The Structural Loads Group will include Structural Development Analysis Studies in Methods, Data Management, Material Stressing Analysis.

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cable masts from a 5-ft dia. tank. Wallick and his associates must even see the performance of the cable lead to the end point what the attenuation will be for the remainder of the run to Pump Room. This must be done at a time when less than 40% of the run has been deployed in the ocean floor. They must take account of ocean depth temperature measurements made in water by the Omega and receiver measurements made during the Navigator's run to Ground Turk.

### Work Around Clock

Working around the clock, Wallick and his group must then adjust the equivalent, attempting to balance the attenuation so it is evenly distributed across the 190 ft bandwidth to be used. The equivalent must be tested for performance, subjected to insulation resistance and high-voltage tests, and then placed in its container with housing. The latter is welded, checked for integrity, using an electronic leak detector, and filled with dry nitrogen through small tubes which finally are plugged and sealed.

The equivalent then is placed into the end of Block A, and the observations of the equivalent and cable back to Ground Turk are measured. Finally, the other end of the equivalent is placed over the beginning of the Block B cable.

The 24 hr. effort for this entire operation include about one hour of clock time to accommodate unexpected troubles. It more serious distribution issues, the day must close down before 21 hr., taking possible damage to the cable.

Fortunately, during the Ground Turk to Runway run all went well and the job was much completed within the allotted time. Equalization achieved was twice as good as required by specifications.

### Contract Old and New

Cable splicing operations show as rehearsing contrast of the modern and the old. Splices must be made at each towpoint, to short cables laid earlier by the Omega, and again when the equivalent is received. Precise welding means is used in one the correct connections and separate cables connect the conductors in polyethylene insulation, after which the insulation is X-rayed for leaks or other defects. But the remainder of the splicing operation, involving the copper tape, wire, tape, wire and tape covering, together with additional wire and tape banding, follows procedures which date back to the earliest cables laid nearly a century ago.

Human ingenuity, muscle and ropes play a dominant role in splicing the

## CAREER OPPORTUNITIES IN THE AREAS OF DALMO VICTOR SYSTEM CAPABILITIES

The sophisticated computerized systems of the future offer endless challenges. Dalmo Victor's capabilities in these areas create opportunities for career opportunities in many of which, ingenuity and ability.

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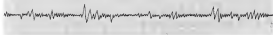
**3. MICROWAVE SYSTEMS** Dalmo Victor has been actively committed to advanced systems for many years. Leadership has been achieved in telemetry, electronic tracking, communications and electronic warfare with capabilities for satellite communications control and anti-aircraft systems.

**4. MAGNETIC SYSTEMS** Another Dalmo Victor achievement area, involving such unique developments as anti-submarine and underwater warfare systems, space vehicle navigation and attitude control systems and other contributions in magnetic and related fields.

**5. AIRCRAFT SUPPORT EQUIPMENT** In partnership with California Technical Industries, another Dalmo company, Dalmo Victor supplies modern air support equipment and ground environment equipment. From a highly effective combination of facilities and talent, Dalmo Victor provides important single-source responsibility.

The page opposite describes one of the many Dalmo Victor achievements. Dalmo Victor and engineers of greatest ability are needed to further this and other Dalmo Victor concepts. If you would like to work in this innovative atmosphere, and enjoy the many advantages of living in the San Francisco Peninsula area, investigate a career with Dalmo Victor. It can be most rewarding.

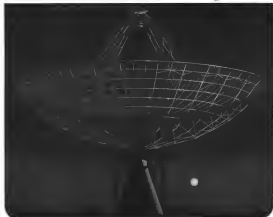
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Now the risk of space dust on a deep space probe can be "heard" from 50 million miles out. With such sensitivity, the new maser, constructed and controlled by Dalmo Victor is designed to become an integral part of NASA's Deep Space Instrumentation Facility at Goldstone, California. This DV maser control is part of an extremely low noise superheterodyne receiver operating with appropriate data processing units which feed information to the Goldstone instrumentation complex, and provide radio astronomy data probes or satellite data as required. This instrumentation system, built under contract to Microwave Electronics Corporation is another example of Dalmo Victor's fully integrated systems capability. DV is in the vanguard of new developments in its major product areas. If you are interested in becoming part of these challenging programs, Dalmo Victor currently is inviting applications from qualified scientists and engineers. For further information contact: Director Scientific and Engineering Personnel.

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# INTERNATIONAL AIR TRANSPORTATION ISSUE

October 7, 1963

To meet the information challenge created by the international character of aviation, AVIATION WEEK & SPACE TECHNOLOGY publishes each year an issue devoted to international air transport progress. This issue is motivated by such enthusiastic response that it will again be greatly expanded to provide the most comprehensive analysis and forecast of the air transport industry and its technical developments.

Publishing date is October 7, 1963, timed to coincide with the annual general meeting of the International Air Transport Association (IATA) in Rome. Copies of the issue will be flown to Rome for distribution at the opening plenary session to arrive presidents, IATA delegates and other world aviation leaders.

Issues there will be the current problems in international air transport including bilateral agreements, rates and tariffs, flight capacities, passenger, mail and cargo traffic, traffic control, the capacity issue, exchange of international routes. Other subjects considered to a full analysis of the airline industry world will be stressed including trends in aerospace transport development, military transport operations, survey of U.S. and Communist Bloc airline activity, impact of U.S. international transport policy on world political and industrial relations.

Feature treatment will be given to trends and projected future prospects for traffic growth and development of flight equipment in all major world markets, North and South America, Atlantic, Pacific, Europe, Africa, Middle and Far East. Ample illustrated, it will also contain specially prepared charts and graphs to show growth and latest trends.

This impressive list of topics slated for coverage will involve the world-wide editorial staff of AVIATION WEEK & SPACE TECHNOLOGY. Testimony of the issue date coincided with AVIATION WEEK's reputation as the authoritative, respected voice of international aviation promise to make it the most important advertising opportunity of the year for your equipment, products and service to the airlines. Identify your role in air transport at a time when attention will be focused on major industry issues.

**Aviation Week  
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McDONNELL TECHNOLOGIES have important place in cable being positioned. Electric welding technique welding and X-ray equipment are used to join steel cable conductor sections and examine the splice for flaws.

the terminal station end of cable at a depth of several thousand feet and transferring it from the barge to the stern once it has been landed on board. During these difficult cable handling operations, a ship must be carefully maneuvered on the water. The 191 ft. long Nixonia, which weighs about 20,000 tons when loaded with cable, is not fitted with a 500-hp cable transfer locomotive as its own powered screw and a 400-hp transverse propulsion hauler in the bow which enable it to run on the powerful drive or to move laterally to the left or right.

#### Auxiliary Bridge

Ship can be steered either from the main bridge or an auxiliary one located in the stern near the port out board. Aboard Nixonia, of modernity includes closed-circuit television which enables the bridge to see from cable transfer room to watch cable coming up from the hold and pay-out out over the stern. But a contrasting touch from the distant past is the method for moving

and introducing the recovery slack into the submarine cable, as it is paid out. The slack must be sufficient to allow the cable to maintain its in the downward tension, which often includes variations thousands of feet feet, yet not too much slack which will prevent the cable to twist itself into a knot.

#### Piece Wise Used

At the time that the cable being laid, steel pieces were which is weighted at the lower end and begins to pay out from the stern. Because the pieces are held the weight of the submarine cable, it does not sink to the ocean floor and its length paid out is roughly proportional to the linear distance traveled by the ship. Using this as a reference, the submarine cable is paid out at a slightly higher rate, providing between 4% and 7% slack. The lower limit is used when the ocean floor is extremely flat while the higher rate is used over extremely mountainous or undulating terrain.

The system used in the AMR

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Requires advanced experience in aircraft preliminary design; or expert knowledge in aircraft performance, stability and controls.

#### AERODYNAMICS ENGINEERS

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Send complete resume, in confidence, to: Thomas S. Shropshire, Professional Employment Manager, Lockheed Georgia Company, 634 West Peachtree Street, Atlanta 3, Georgia, Eps. 10-75.

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Space-orbital entry of a space vehicle—one returning to earth from a planet, rather than from an earth-orbiting mission—would result in seeing radiative heating in addition to the more familiar convective type. As a spacecraft nose enters atmosphere, it pushes the thin air aside. A heating layer is formed next to the skin. Ahead of that is a compressed mass of air; trailing that, a shock wave. The air behind the shock wave becomes ionized, heated, and reacts to the heat shock. Within the boundary layer, friction heats the nose cone by convection.

Lockheed scientists believe that at higher than escape speed a blunt-nosed vehicle may be unable to sustain the radiative heating. Consequently, a return to the previously discarded sharp nose is



indicated. Fluid mechanics are calculating the heat load, determining how rapidly the nose will ablate and how to keep it sharp. Current shock tube tests are providing some clues.

Another research project in Lockheed's Fluid Mechanics Laboratories relates to the flow of buoyant fluids. A typical study program is the determination of how liquid hydrogases, stored in a tank in space, stratifies. This, in turn, determines the level of pressurization required in order to extract all of the fluid. Scientists make a mathematical model of what they think occurs inside the tank. With this as a guide, an actual tank was constructed to obtain measurements and photographs of the flow to verify their theories.

**LOOK AT LOCKHEED... AS A CAREER** Candidate Lockheed's leadership in space technology. Evaluate its accomplishments—such as the Polaris missile, the Agena vehicle's superb record of space missions. Examine its outstanding advantages—location, advancement policies, creative climate, opportunity for recognition.

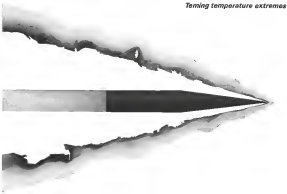
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## LOOK AT LOCKHEED IN FLUID MECHANICS:

*Timing temperature extremes*



## 1977 FILTER CENTER 1978

► **Linear Display Effect Planned—**USAF's Aeronautical Systems Div. is seeking qualified sources to investigate techniques for design of a television type display which could be produced by a laser instead of an electron beam.

► **Solid State Transceiver Single—**Rouse Air Development Center plans to sponsor development of an airborne VHF and UHF transceiver for ground air communications using all solid state construction and weighing less than 10 lb each. The VHF unit is to provide 1,120 channels in the 160-156 mc band while the UHF transceiver is to provide 3,500 channels in the 125-400 mc band. Industry proposals should be identified 8-9-95 and U-4-95, respectively.

► **Optical Transceiver Study by RADCOM—**Study program to determine small characteristics required in a laser communications transceiver designed to operate over path lengths of more than 10 mi., with a channel capacity of one billion bits per second, is planned by Rouse Air Development Center. Air sponsors should be identified U-4-11.

► **Fixed Laser Area Planned—**Rouse Air Development Center is seeking qualified sources for feasibility studies of a coherent optical area consisting of laser oscillators, power amplifiers, detectors, phase shifters, power dividers and beam steering systems. RADCOM also is seeking sources to investigate techniques for development of continuous wave laser oscillators, power amplifiers and heterodyne detectors all operating at a wavelength frequency, using solid or gaseous materials.

► **Naval Seals Field Effect Microcircuit—**Naval Buena Vista Ship plans to sponsor program to develop microcircuit devices incorporating using field effect active devices. Rouse Air Development Center is seeking sources to develop techniques for vacuum deposition of thin film thermoelectric insulating devices on thin film microcircuitry.

► **MMIRM—**Getting New Microcircuit Computer—Sperry's current guidance system being developed for the mobile midcourse missile attack (MMIRM) by General Precision Corp. employs a new digital computer constructed largely of nonconductor microcircuits. A number of the new components, 24-bit version of its "summa" system (AW Dec 24, p 41) have been delivered by the Univac Div. of Sperry Rand to General Precision.

## About paper for direct-writing oscillographs:

Always order an "KODAK LENSAPHOR Direct Print Paper." The name has been around for a while, but what it covers is always subject to improvement. Today's Kodak LENSAPHOR Direct Print Paper permits the same high writing speed as hitherto. The trace pops up quicker, however. It's darker on a lighter background. It keeps longer before treatment for permanence. It looks better after the treatment.

Why not have the benefit of little advance like that as soon as they come out? Keep in touch with Eastman Kodak Company, Photorecording Methods Division, Rochester 4, N. Y.

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## PROBLEMATIC RECREATIONS 182



Show that two WRONG's can make a RIGHT, just with the additional restriction that 0 = 1000.

A random check of the new products list from our RADCOM Emerging division revealed the following development: a new, modified, lower-cost version of the standard Air Force electronic calculator was announced to cost less from 0-40 feet and 5% from 40-5000 feet. Many military specifications, of course. They call it Model 1360. Direct an inquiry to RADCOM Emerging, 1346 E.W. Highway, Silver Spring, Maryland.

Answers to Last week's puzzle: If we let the widths of the three farms be A, B, and C, we have: A (A + B) = 8 (B + 29) > C (C + 34). The equation A (A + B) = 8 (B + 29) has solutions A = 3, B = 4 and A = 40, B = 32. Only the latter satisfies the third equation, yielding the value C = 30. The farms are, therefore, 40x32, 32x60 and 30x40, all containing 1920 sq. mi.

**LITTON INDUSTRIES, INC.**  
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**USS HANCOCK (LPH-15).** Overboard way above, features a loading dock for its 19 helicopters, an approach control tower (port side masthead) and a crane for hoisting boats. Ship carries 900 Marines and landing craft for heavy equipment.

## Navy Building Helicopter-Attack Vessels

By Ward Wright

New York—New class of Navy transport (LPHs)—designed from the keel up to deliver a complete combat unit with its tanks, artillery, vehicles and equipment by a landing craft helicopter combination—will become part of an amphibious fleet of fast attack vessels planned for the mid-1970s.

Plans for such a fleet to satisfy Marine Corps requirements for rapid, remote delivery of two reinforced Marine divisions—two such as the Atlantic and Pacific—by helicopter and landing craft, have been approved by the chief of naval operations and the secretary of the Navy, Delaware Dept. is now studying the plans for inclusion in the Fiscal 1967 defense budget.

Present Navy plans call for 10 to 14 LPHs by the early 1970s. Ninest of the class is the USS Vancouver (LPH-2) commissioned in May and commanded by Capt. Thomas C. Horlitz. It USS Raleigh (LPH-1), was commissioned Sept. 1, and joined the Amphibious Force, Atlantic Fleet in April 1968. La Salle (LPH-3) is under construction at New York Naval Shipyard,

Brooklyn, and is scheduled for christening early this month. La Salle has an additional deck for the facilities. The class is named for U.S. cities named after explorers.

Keels were laid simultaneously at Brooklyn for USS Austin (LPH-4) and USS Ogden (LPH-5) last February. Both are scheduled for completion in June 1969. LPH-6 is slated for keel laying at Brooklyn in November and LPH-7 and LPH-8 are under construction at Ingalls Shipbuilding Corp., Pascagoula, Miss. LPH-9 and LPH-10 are being built at Puget Sound Bridge & Drydock Co., Seattle, Wash.

Vancouver, keel of her class, a 533 ft overall, has a beam of 51 ft, displacement 14,000 tons, and draws 21 ft fully loaded. Six outboard motor tugs three 900-hp fully equipped combat troops in addition to a ship's company of 450 men and 27 officers.

Her helicopter platforms occupy part of the hull but her top deck is a flexible landing deck containing landing craft which are launched through the stern. Super launch, she resembles Navy's LST (Landing Ship, Dock) class which has

no bulk in helicopter capability.

While the full measure of LPH capability is still unknown, due to numerous present thinking is that LPHs would be assigned permanent complements of helicopters. Most likely, helicopter operating from LPHs (AWAP, p. 25), which carry about 2,000 troops and in some, as 30 helicopters, will be ferried to the LPHs where they will remain for the duration of a specific mission.

Depending on the mission, LPHs will be assigned right to H-H Mobile UH-1A, or to Sikorsky CH-53C, CH-53A or Boeing Vertol CH-46A helicopters.

On board helicopter facilities include power fueling and a shop to perform routine maintenance. No provision is made for launching helicopters below decks. A flight approach control installation on the port side facing aft gives an unobstructed view of the landing platform during takeoff and landing.

Below, major engineering considerations create unusual rapid loading of helicopters and landing craft, and flooding and emptying the well, or deck.

The well deck, itself consists of a hinged-like, rectangular room below the

helicopter deck. At the forward end is a vehicle storage area, serviced by elevators from the two cargo holds below. This area also serves as an equipment assembly area for gear arriving from the holds.

The vehicle storage area gives way to a ramp leading to the well or deck. The well is shallow near the ramp and deeper near the stern where it is closed off from the sea by doors hinged top and bottom. In the well, pre-loaded landing craft rest on their bottoms until the stern doors are opened, flooding the deck, and then they are released. Tracked vehicles can be driven out without flooding.

Around the perimeter of the well deck, are bridge cranes rising around an overhead track laid out like a horse shoe, pick up cargo of weapons and supplies from the vehicle storage area and deposit them in landing craft. These cargo are brought up from the holds in a truck and elevator or in a scissor elevator that lifts the load. The smaller elevator serves both the vehicle storage area and the helicopter deck.

Two pilot cranes are used to bring additional cargo from the forward holds back to the vehicle storage area where the bridge cranes can reach them. During an operation, load lift trucks help move loads on both the well and helicopter decks.

Since some missions may call for a deck load of arms which arrived at helicopters, a scissor-like ramp has been provided so they can be driven from the helicopter deck to the vehicle storage area.

In a landing operation, pre-loaded landing craft would enter the well's airlock, and return through the stern to the ramp. Equipment and vehicles from the vehicle storage area would be conveyed as driven directly onto the waiting, landing craft by the elevator. The process is repeated until the desired amount of equipment is aboard.

Meanwhile, at helicopter lift a part of the operation, reinforcements would be continuously lifted from the helicopter deck to their ships. For some missions, however, all troops might be landed from boats.

Vancouver carries a mixture of landing craft which like the helicopters, is declassified by mission. Built around the well deck include one LCU (Landing Craft, Utility), and three LCM-6s (Landing Craft, Mechanized), or six LCM-6s, at least eight LCM-8s, or 20 LCM-8s (Amphibious) in a combination of any of these. She also carries two LCM-8s or two LCM-16s (heavy commando's boats) on the front deck which are lowered by crane.

All of Vancouver's boats and machinery are modified to burn JP-5 turbine fuel for simplicity and ease of supply. The main boiler can be fired



**HANCOCK'S STERN** shows the large doors leading to the well or deck, through which landing craft carrying equipment are launched while troops are drilled ashore.

by JP-5 as an emergency situation.

The other major design considerations, rapid fill and emptying of the well, is achieved with a valve-type ballast system. This older LST design pumped water from the ballast tanks automatically, but Vancouver blows it out with air from five entry compressors.

Fresh flooding, Vancouver's well holds about 6,550 tons of sea water at a depth of 4 ft near the ramp and 30 ft near the stern. Its grossing her 12 ballast tanks holding 3,300 tons of sea water to 15 ft, Vancouver can blow to a dry well in 15 min, using her high capacity to shut her stern doors and get under way. The remainder of the ballast is pushed out of her tanks in about 35 min by the compressors. Dredged material can be directed to the ballast tanks to supplement the compression in an emergency.

Vancouver's troop compartments are open to the ocean standards but as an improvement over World War I and Korea. Wave surge impacts. The ship is effectively air-conditioned throughout, the stern areas being air forced with 2-in. thick foam rubber mattresses, and music can be piped to troops over a separate audio system.

Colapsible seating tables and benches can be attached to structures which support the banks. Troops have small individual lockers for personal effects and larger lockers in adjacent compartments for jackets, air bags and supplies. Most lockers are fitted out with seats so troops do not have to stand to rest in aboard older transports.

Vancouver contains a complete combat laboratories center (CLC) to keep Marines and Navy commanders abreast of troop progress and the total ac-

tion picture. The center houses a Navy Tactical Data System, radar viewing equipment, and electronic communications and communications equipment.

Her machinery—two 12,000-hp General Electric steam turbines gear driven by Babcock & Wilcox boilers and coupled to two screw driven Westinghouse reduction gear—gives Vancouver a maximum speed in excess of 20 kt.

Vancouver's maximum combat of eight 3 in. 50 cal. automatic guns is two battalions.

There are no land and rail rules for the employment of helicopter-carrying vessels in an assault. Despite the problems and gloss of helicopter transport, Marines are quick to point out that the availability of landing troops, weapons and supplies on a beach from the sea has not been duplicated. At the Vietnam effort part of it. After modified helicopter assault for landing, we discussed the troops still had to get out.

What he happened to the amphibious air concept since the Korean War is that future landings will have to work within the limitations posed by nuclear threat.

These limitations mean that weapons and transports can't be loaded off a beach and be for them discharging and unloading in they did during Vietnam War. A modern amphibious force will have to assemble quickly, aimed what it would, when it needed—no merely dumping a mass of material on the beach—and depart.

At the last time, the ground commander will need support from the sea as he always has. Vessels such as Vancouver and the troop and ac-





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carrying LPH class give the ground commanders two-thirds support from a dispersed position 25 to 50 air from the beach—and another dimension to his attack.

With helicopters, he can strike by land or on the beach, or he can launch them in places where his tanks are concentrating difficulty. He can take his ship-based helicopter attack to come before, after, or at the same time as his waterborne assault. Or, he can hold his helicopter force in reserve miles away from the target.

While a vessel such as Vincennes commands the characteristics of fast Navy ship classes AKA cargo transports, APA troop transports, LPH helicopter aircraft carriers, and LSD dock ships, it is not meant as a replacement for any of them. Most still exist for rapid response of most of these types. What the LPH gives is a new measure of flexibility in taking the fight to the enemy.

Marines and Navy reached agreement for the first time this year on the type and number of amphibious and helicopter units needed for the 1970s. While the actual types and numbers planned are secret, the fleet will probably contain in addition to other types, about eight LPHs, 14 LPDs, a few

precursors of 20 to 25 LSTs (landing ship, tanks), and some fast reefers, not all attack transports. The reinforced fleet will probably have about 130 ships—the present total of the combined Atlantic and Pacific amphibious fleets.

Navy now has seven LPHs, fast converted from aircraft carriers and three new construction ships built from the lead up for helicopters. An eighth LPH-8 is slated for completion in late 1969. LPH-6, USS Thetis Bay, converted from a World War II "Anzac" class carrier, will be retired in the next few years. LPH-4, -5, and 6—the USS Boxer, USS Princeton, and USS Valley Forge—all converted from "Essex" class carriers, will be retired and replaced by the early 1970s.

One problem of considerable concern to the Marines, which has not been resolved in plans for a modern amphibious fleet, is the growing shortage of Navy crews of all caliber for beach head support.

At present, Navy has no ship in commission which can fire an shell larger than 5 in. and it has few of these. Despite the role of tactical air power, Marines feel that for penetrating shore installations cheaply and accurately, aerial gunfire is still best.



### Rocket Engine Placement Shown on NF-104A

Theritable AR-2 rocket of 6,000 lb thrust is shown mounted in test run of three NF-104As, currently being launched California Sea Air Force's Aerospace Research Pilot School at Edwards AFB, Calif. Rocket will help boost aircraft to 120,000 to 170,000 ft, where hypersonic speeds enable jets in same and weight will be used to transfer re-entry into the atmosphere. (NW July 22, p. 357)

## NEW AEROSPACE PRODUCTS

### Static Inverter

Static 90-w amp. inverter is designed to supply power to flight instruments. Unit converts 28 v d.c. to 115, 40, or 6 v a.c. at 400 cps. Inverter, Part No. 26130073, oper-



ates in input voltages as low as 20 v and can withstand 90 v d.c. transient input voltages down to 6 v d.c. will not damage the unit.

Measuring 5 x 4 x 2 1/2 in. and weighing 2 1/2 lb., the inverter has a 2,500-hr. minimum service life and operates in ambient temperatures from -35 to +70°C.

Viper Corp., 6444 W. Howard St., Chicago 48, Ill.

### Grygonis Refrigerator

Modular cryogenic refrigerator, Model 487100, will operate from 35 500K, weighs 10-12 lb., exclusive of 20 v d.c. motor and measures 4 x 5 x 12 in.



Input power is 208 w at 30K and 360 w at 100K. Cold production of the refrigerator is approximately 1 w at 30K and 10 w at 100K.

Cooling area size depends on temperature required and resolution. Unit

is designed for constant cooling or remote cooling by reconnection, according to the manufacturer.

Cryogenics Div. of North American Philips Co., Inc., Meriden & Appleton Roads, Appleton, N.Y.

### Business Aircraft Heater

Heater is designed for single- and two-engine business aircraft. It operates on the ground as well as in flight and requires no engine warmup the manufacturer says.

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hr. outputs weight 151-27 lb. and is 20-26 in. long, with a 5-6 in. dia. on cooling. Excluding the electronic housing unit, depending upon which capacity heater is required. Heater is FAA approved.

General Aero Div., Mullins-Klaus Corp., 4280 Surface Rd., Columbus, Ohio.

### Heating Rate Transducer

Model C-1119 is constant frequency, with fast response time, is designed to measure transient heating rates on materials and spacecraft. A small diameter of 0.125 in. permits its use on curved



surfaces without disturbing aerodynamic configurations. Length is 0.165 in.

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Hi-Cal Engineering, 12105 Los Nietos Rd., Santa Fe Springs, Calif.

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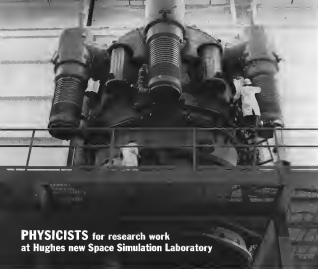
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lems of a perfect simulation of very large vacuum chambers? To investigate these areas, Hughes Space Systems Division is organizing a small research group to support the efforts of the new Space Simulation Laboratory. Specific projects and programs being designed and developed are the SURFACOR (surface coating research vehicle), SYNCOM (synchronous communications satellite), several types of anti-missile missiles. Some of the key positions open now include:

**Research Physicist.** A doctor's degree in some physical science is required. The position would involve major responsibility for the planning and direction of research projects in the Space Simulation Laboratory is mandatory efforts. Also involved would be the development of Space Simulation Physicists in planned programs and projects.

**Experimental Physicist—Optics.** The major responsibility would be to plan and fully comprehend all the work in the field of optical systems. The work would involve the development of high temperature sources, gas discharge optics, evaluation of the optical properties of materials, etc. Laboratory work on integrated optics will be a vital part of the program to determine the reliability and operational characteristics of commercial and the Space Systems Division requirements.

**Vacuum Technology.** Doctoral or master's degree in the field of ultra-high vacuum under conditions of high mass flow.

**Cryogenics.** It will be necessary to evaluate the use of cryogenics in the development of ultra-high vacuum and the development of surface properties of cryogenic temperatures. Ph.D. with experience in cryogenics is preferred.

**Theoretical Physicist/Mechanics.** A Ph.D. in physics or related field with unique capabilities in the development of theoretical models and the development of surface properties of cryogenic temperatures. It will be necessary to evaluate the reliability and operational characteristics of commercial and the Space Systems Division requirements.

Applicants should have a degree from an accredited university. U.S. citizenship required. Hughes is an equal opportunity employer.

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Head of Employment  
Hughes Aerospace Division  
1140 W. Jefferson Blvd.,  
Culver City, CA, California



## WHO'S WHERE

(Continued from page 23)

### Changes

**Gordon Buckman**, senior assistant, Aerojet General Corp.'s Liquid Rocket Plant, Sacramento, Calif.

**W. Robert Aitchfield**, assistant to the general manager, Aerojet Div. of General Controls Corp., Downey, Calif.

**Dr. James W. Singleton**, manager, Washington Div. Systems Development Corp., with offices in Falls Church, Va.

**William D. Kohnen**, marketing director for Lear Jet Corp., Wichita, Kan.

**Malcolm J. Berg**, assistant director, Engineering Materials Laboratory, Space Technology Laboratories, Inc., Redlands, Calif. a subsidiary of Thompson Research Works, Inc.

**Dr. Maurice Glickman**, director of research, Laboratories RCA, Inc., Tucson, Ariz., according to Dr. Martin G. Steele, who is returning to the David Sarnoff Research Center.

**George J. Vile**, manager of the newly established Cleveland office of General Dynamics Corp.

**Dr. Edward A. Wolf**, manager, Space Engineering Laboratory, Aerojet Astro Corp., Culver City, Calif.

**David B. Erdle**, manager, Technical Coordination and Administration, Boeing and Ford Tech. Group, San Bernardino, Calif.

**Operations of Aerospace Corp.** (formerly the Aerospace Operations group) with Robert F. Newbold, manager, Sub-Sector Station, Advanced Planning Div., Dr. Robert G. Wilson, chief, Materials and Instrumentation Section, Radar and Communications Dept., Arthur O. Hume, head, Army and Navy Section, Radar and Communications Dept., Robert L. Smith, assistant manager, Energy Vehicle Section, Mobile and Range Ballistic Missile Program, SAMBREM, William C. Young, assistant director, Adaptive Systems Program, Engineering Div.

**Robert Zwart**, supervisor, Project Engineering Dept., Aerospace Div. of Honeywell, Waukegan, Ill.

**Dr. Herman J. Lunn**, director, Systems Research and Development Center, San Francisco, Calif. (The California operations of ITT Federal Laboratories, Inc.)

**Thomas A. Fitzgerald**, director of advertising and public relations, SKF Industries, Inc., Philadelphia.

**Richard G. Lunn**, director, Federal Systems Marketing Div., Honeywell Electronics Div., Phoenix, with offices in Phoenix, Ariz., and in Culver City, Calif.

**Donald P. Brennan**, new director of the newly established ETR Applications Engineering Div.

**Dr. W. W. Kane**, manager of industry and control programs, WDC, Div. Philco Corp., Falls Mills, Calif., and Edward C. Berman, manager of field operations.

**James M. McVittie**, manager of engineering, West Coast Operations (Korn, Menlo, Calif.) for Philco/Emco Corp.

**William K. Lewis**, manager of public relations for the Washington, D.C. office of Aerojet-General Corp.

**Carl S. & Folsom**, director of Materials Section, Oklahoma City Air Material Area, Tulsa, Okla.

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